Master's Research Report

Evaluating Lean Implementation Success in Small and Medium Manufacturing Enterprises

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DECLARATION

I, **Robin Mabunda**, hereby declare that this master's research proposal is wholly my work and has not been submitted anywhere else for academic credit either by myself or another person. I understand what plagiarism implies and declare that this proposal is my ideas, words, phrases, arguments, graphics, figures, results and organisation except where reference is explicitly made to another's work. I understand further that any unethical academic behaviour, which includes plagiarism, is seen in a serious light by the University of Johannesburg and is punishable by disciplinary action.

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ABSTRACT

This study investigates lean manufacturing among South African small, medium and micro (SMMEs) manufacturing enterprises based in the Gauteng Province. Lean is widely regarded as a proven productivity improvement methodology; yet, its impact on South African SMMEs remains relatively unknown. The study used a mixed method approach. Survey data was analysed using statistical methods from 32 responses received from SMMEs in various manufacturing sectors. Interviews were conducted with management and workshop employees. The results revealed that most SMMEs experienced short-term successes that did not exceed three years, implying that they failed to sustain the gains of lean manufacturing. Factors found to have a positive impact on the success and sustainability of Lean implementations were change management, adequate budget, resources with appropriate skills, senior leadership commitment, and adherence to an implementation plan. These results contribute to the lean implementation theory and can be used as a guide by lean practitioners.

TITLE

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1.1 Introduction

The South African economy has since the 2008 global economic downturn struggled to reach a Gross Domestic Product (GDP) growth target of 6% (Trading Economics, 2018).

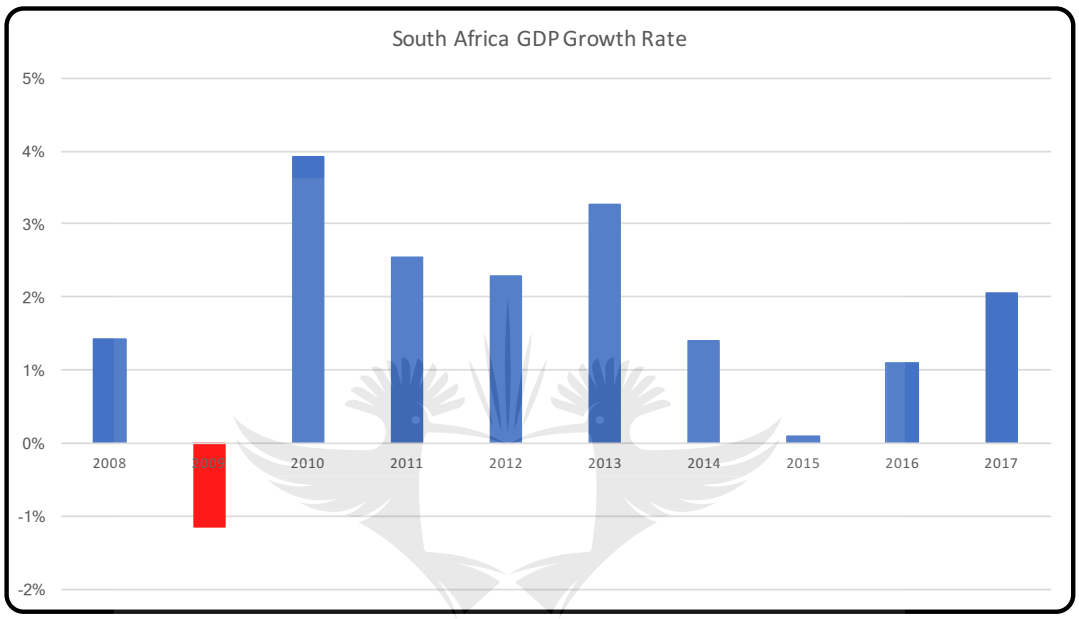

Figure 1.1: South Africa GDP Growth Rate

Source: Trading Economics (2018)

The inability of the South African economy to reach the targeted GDP level of 6% has had negative societal consequences resulting in high unemployment, poverty and inequality. According to Amra, Hlatshwayo and McMillan (2013), small, medium and micro enterprises (SMMEs) are globally credited for being the main driver of equitable economic and industrial development. South Africa has relatively low levels of entrepreneurship with SMMEs accounting for only 55% of employment compared to 90% in China, India and Indonesia (Lekhanya, 2015).

To become competitive, companies have looked at means of improving their manufacturing processes by introducing systems (Moorthi, 2008). These systems include six sigma, lean manufacturing, theory of constraints and process re-engineering. Of all manufacturing improvement systems, Lean has been credited for dramatically increasing productivity in

companies that have implemented it (Rothenberg & Cost, 2004). Through Lean, continuous reduction of waste becomes the central focus, rather than a series of once-off initiatives (Christodoulou, 2008).

1.2 Motivation for the Research

South Africa is facing an uncertain economic outlook over the next few years, and improving productivity amongst SMMEs will play a key role in ensuring SMME competitiveness. As SMMEs continue to face challenges in remaining profitable during periods of economic difficulty, some have adopted productivity improvement methodologies as a strategy for improving competitiveness. SMMEs have used Lean over the past decade with the aim to improve productivity (Productivity SA, 2016).

There appears to be a significantly lower uptake of Lean in small and medium enterprises (SMEs) when compared to larger enterprises, and most SMEs are still unfamiliar with Lean (Hu, 2015). Research indicates that this is due to many factors that will be further explored and examined in this research study. While there have been several studies that have addressed Lean implementations in general (Coetzee, Van der Merwe & Van Dyk, 2016; Pitout, 2006; Vyas, 2011), many focus on large enterprises rather than SMEs. Very few studies focus on Lean implementation in SMEs and rare research studies focus on Lean implementations in South African based SMMEs. This study focuses on contributing to filling this gap by conducting a systematic study into Lean implementations in South African based SMMEs.

1.3 Research Aims

This research aims to establish the success rate of Lean implementations in small, medium and micro-manufacturing enterprises (SMMMEs) based in South Africa. The research further aims to identify factors that influence a Lean implementation outcome and the sustainability rate of Lean implementations. The research intends to identify multiple SMEs that have implemented Lean in South Africa as their means to productivity improvement, analyse the success rate of these implementations, and further understand factors that influence the outcome and the sustainability rate of these implementations.

1.4 Report Structure

Chapter 1 discusses the current environment that South African SMMEs face and provides the motivation for the implementation of Lean manufacturing as a solution to driving productivity and sustainability.

Chapter 2 reviews the literature on the concept of productivity as it relates to Lean manufacturing and SMMEs in South Africa. It further outlines the views of those involved in implementations and focuses on factors that drive successful Lean implementations.

Chapter 3 focuses on the research questions that this research study aims to address.

Chapter 4 outlines the research methodology and criteria applied in the selection of the population and sample, covers the collection of the data and discusses the analysis approach of the data.

Chapter 5 presents the data collected. The data is offered in a categorised, consolidated format based on the themes that emerged from the survey questionnaire.

Chapter 6 presents the data collected. The data is offered in a categorised, consolidated format based on the themes that emerged from interviews.

Chapter 7 details the results of the research as it relates to the research questions and to the literature reviewed.

Chapter 8 articulates the merits of this research and provides recommendations for the effective implementation of Lean in SMMMEs based in South Africa.

Chapter 2: Literature Review

2.1 Introduction

South African manufacturing-based small, medium and micro enterprises (SMMEs) have in the last few years embraced and implemented lean manufacturing as a key manufacturing and management approach to improving productivity and managing competition. Little is known about the success rate of these implementations and overall impact on the economy. With this background, it is imperative to understand the characteristics of both lean and South African small, medium and micro-manufacturing enterprises (SMMMEs). This chapter provides an outline into the body of knowledge currently available on SMMEs and Lean.

2.1.1 Definition of SMME

A single, uniformly accepted global definition for SMME does not exist (Altenburg & Eckhardt, 2006). Different countries or economic regions tend to develop their own definitions based on a widely accepted practice that a definition of SMME comprises some or all of the following three parameters namely:

1. number of employees;
2. annual turnover; and
3. asset value

Though the above are generally accepted parameters for defining SMMEs, Le Fleur et al. (2014) argued that SMME definitions are broadly categorised into "economic" and "statistical". The economic definition considers three criteria that a business has to meet, namely:

1. size of market share;
2. management by owners or part owners; and
3. is independent (i.e. not part of a larger enterprise or group of companies)

As opposed to the economic definition of SMMEs, the statistical definition considers the following three criteria:

1. size of the business and its contribution to GDP, employment and exports;
2. extent to which the business sector's economic contribution has changed over time; and

3. cross country comparison of the business' economic contribution.

The United Nations Industrial Development Organisation (UNIDO) generally advises countries to consider quantitative and qualitative indicators for SME definition (Dababneh & Tukan, 2007). Table 1 below, summarises the main qualitative indicators that could be used to differentiate between SMEs and large businesses.

Table 2.1: Application of Qualitative Indicators

Category	SMEs	Large Businesses
Management	▪ Proprietor-entrepreneurship ▪ Functions linked to personalities	▪ Manager-entrepreneurship ▪ Division of labour by subject matters
Personnel	▪ Lack of university graduates ▪ All-round knowledge	▪ Dominance of university graduates ▪ Specialisation
Organisation	▪ Highly personalised contacts	▪ Highly formalised communication
Sales	▪ Competitive position undefined and uncertain	▪ Strong competitive position
Buyer's Relationships	▪ Unstable	▪ Based on long-term contracts
Production	▪ Labour intensive	▪ Capital intensive economies of scale
Research Development	▪ Following the market, intuitive approach	▪ Institutionalised
Finance	▪ Role of family funds, self-financing	▪ Diversified ownership structure,

Category	SMEs	Large Businesses
		access to the anonymous capital market

Source: UNIDO (2005)

Furthermore, the Asian Pacific Economic Cooperation's (APEC) most preferred criterion used within the economies of APEC is the number of employees within the business itself. APEC, therefore, defines SMEs as enterprises with less than one hundred people, where a medium-sized enterprise employs between twenty and ninety-nine people, a small firm employs between five and nineteen, and a micro firm employs less than five employees, which includes self-employed managers (Dababneh, 2007).

It is important to clarify that, the SME abbreviation is commonly accepted and used by many countries such as South Africa, Australia and European Union Member States, and internal organisations such as the United Nations and the World Bank. What is found to differ is the SMME abbreviation. Some countries such as Kenya and India have adopted the MSME abbreviation, standing for Micro, Small and Medium Enterprises (Ministry of Law and Justice, 2006). Other countries such as South Africa have adopted the SMME abbreviation, standing for Small, Medium and Micro Enterprises. Other countries such as New Zealand and the United States of America tend to use the SME abbreviation for Small and Medium Enterprises, and SOHO abbreviation for Small Office/Home Office or Single Office/Home Office (Ward, 2018). SOHOs are the equivalent of what other countries call micro enterprises and employ less than five (5) employees. Below are SMME definitions from an economic block and two countries:

European Union

According to US AID SME definition booklet (Dababneh, 2007), the European Union defines small and medium-sized enterprises as companies with less than 250 employees. The categories are as follows:

- Microenterprises: 1 – 9 employees; Turnover: <$3 million; Assets: <$3 million

- Small enterprises: 10 – 49 employees; Turnover: <$13 million; Assets: <$13 million
- Medium enterprises: 50 – 249 employees; Turnover: <$67 million; Assets: <$56 million
- Large enterprises: 250 employees; Turnover: >$67 million; Assets: >$56 million

Australia

In Australia, the Australian Bureau of Statistics (www.abs.gov.au, 2001) defines small and medium-sized enterprises as companies with less than 200 employees. The categories are as follows:

- Microenterprises: 1 – 4 employees
- Small enterprises: 5 – 19 employees
- Medium enterprises: 20 – 199 employees
- Large enterprises: 200 employees or more

South Africa

In South Africa, the National Small Enterprise Act (SA Government Paper No. 102, 1996) defines SMME categories as follows:

- Microenterprises: 1 – 5 employees; Turnover: <R200 000; Assets: R100 000
- Very small enterprises: 6 – 20 employees; Turnover: <R6 million; Assets: R2 million
- Small enterprises: 21 – 49 employees; Turnover: <R32 million; Assets: <R6 million
- Medium enterprises: 50 – 200 employees; Turnover: <R64 million; Assets: <R23 million
- Large enterprises: 200 employees; Turnover: >R64 million; Assets: >R23 million

It is important to note that, due to the targeted research focus on South African based SMMMEs, the researcher will use the South African definition of SMMEs as the general definition of SMMEs in this research study.

2.1.2 Contributions of SMMEs

SMMEs are globally credited for being the main driver of equitable economic and industrial development. As of 2013, the United Kingdom (UK) had 4.9 million businesses of which 99% were SMEs (Ward & Rhodes, 2014). The European Commission's SME performance review estimates the gross value added of SMEs at 49.8% of the UK economy. Table 2.2 breaks down the contribution of UK-based SMEs for 2013 to 2014 period into further detail.

Table 2.2: Breakdown of formal SMME contribution to the UK economy

	Number of enterprises			Employees	Turnover
	2013	**2014**	**% change**	**2014**	**2014**
	(000s)	***(000s)***		***(000s)***	***(£ billions)***
Micro (0 - 9 employees)	4671	5010	7%	8276	655
Small (10 - 49 employees)	186	195	5%	3807	515
Medium (50 - 249 employees)	30	31	3%	3075	477
Total SMEs (0 - 250 employees)	**4887**	**5236**	**7%**	**15158**	**1647**
Large (250+ employees)	6	7	17%	10070	1874
Total (all businesses)	**4895**	**5243**	**7%**	**25228**	**3521**
SME as % of total	99,8%	99,9%	-	60%	47%
Micro as % of total	95%	96%	-	33%	19%

Source: BIS (2014)

According to Altenburg & Eckhardt (2006), SMMEs play a critical role in overall economic development which, on average, make up for over 90% of enterprises in the world and account for 50% to 60% of employment – particularly in the developing world. In South Africa, the statistics indicate that SMME GDP and employment impact is marginal when compared with UK stats. Table 2.3 summarises SMME contributions to the South African economy taken from Stats SA (2015).

Table 2.3: SMME economic contributions in South Africa

KEY INDICATORS	2015 (Q2)
Number of SMMEs	2251821
Number of formal SMMEs	667433

Number of informal SMMEs	1497860
SMME owners as % of total employment	14%
% operating in trade & accommodation	43%
% operating in community services	14%
% operating in construction	13%
% operating in finance & business services	12%
% contribution to Gross Value Added (GVA)	21%
% black owned formal SMMEs	34%
% operated by income group <R30K per annum	7%

Source: Stats SA (2015)

The most commonly used metrics for SMME contribution to the economy tend to fall into two categories (Amra, 2013), namely employment contribution and GDP contribution. Figure 2.1 summarises SMME employment comparisons between South Africa, the UK and the rest of the world.

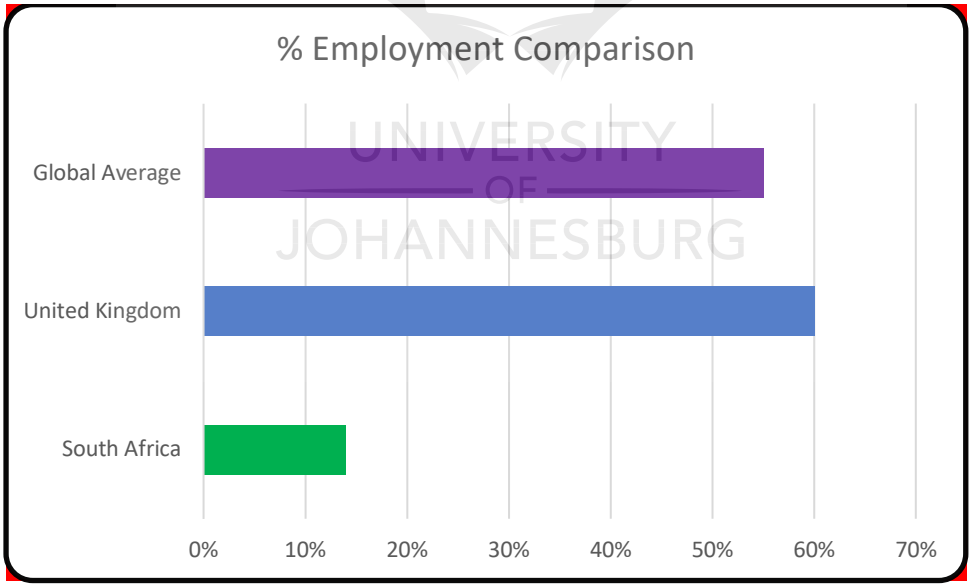

Figure 2.1: Employment Comparisons

The above graph clearly highlights the scope of opportunities available to assist South Africa to deal with the employment challenges it experiences.

2.1.3 Challenges facing SMMEs

Extensive international studies that include the works of Muhammad et al. (2010), the OECD (2014), and Yoshino and Taghizadeh-Hesary (2016) summarise the following key challenges facing SMMEs:

1. **Difficulty in accessing finance** – Given the macro-economic risks linked to the economic downturn and South African banks' highly conservative nature, lenders are more inclined to grant financing to profitable large companies as opposed to start-ups and SMMEs (Fuchs et al., 2011). Working capital issues due to payment factors with customers and lack of finance for whatever reason from financial institutions tend to stifle growth and ultimately, leads to the demise of the business.
2. **Low level of business Research & Development (R & D)** – R & D refers to a process of investigating and analysing ways of improving one's products or processes. R & D is key in staying ahead of the competition. Most countries measure the R & D ratio, which is R & D annual spent as a percentage of annual turnover. R & D is low in Africa and Asian countries. According to Yoshin and Taghizadeh-Hesary (2016), Japan's average R & D ratio was 5% in 2013. The low R & D ratio is normally attributed as one of the key reasons for slow economic growth and failures of SMMEs.
3. **Insufficient use of information technology** – The world has experienced a rapid boom in:
    a. affordable IT hardware (in the form of desktops, laptops, mobile phones and tablet computers);
    b. affordable IT software (in the form of open source technology that includes Joomla, WordPress, and cloud technology);
    c. affordable IT resources for support;
    d. social media access and usage; and
    e. affordable fast internet connectivity (e.g. internet fibre).

Even with all the affordable information technology, there are many SMMEs that do not sufficiently use such opportunities. Many SMMEs do not have websites (for e-commerce utilisation) or mobile payment solutions.

4. **Low productivity** – Productivity refers to the effective utilisation of resources to produce outputs. According to Kreuser & Newman (2018), some sectors of the South African economy are improving their productivity levels but SMMMEs continue to struggle with low productivity. A correlation between productivity and R & D was also observed (i.e. when R & D was low or non-existent, productivity was low, and vice-versa).
5. **Government bureaucracy and regulation** – Government bureaucracy and regulation refers to elements that include the process of applying for government grants or assistance (with the potential to result in extensive delays and delays in acquiring permits or licenses).
6. **Access to market (both domestic and international markets)** – As in Brazil (White, 2005), large businesses tend to dominate economic performance in South Africa. This is largely attributed to the sanctions experienced by the country that forced the country to develop certain industries for self-sufficiency. This historical element and its impact can largely be seen when observing export trends; South African exports are largely dominated by large businesses.
7. **Lack of managerial capability** – Most SMMEs are typically founded by technical specialists; individuals that do not necessarily have managerial experience or full appreciation of managerial skills. If good management skills are not brought into an SMME, most tend to close shop after a few years or soon after the founder departs the business.

Though the above challenges can also be found in South African SMMMEs as indicated by Berry et al. (2002) and Fuchs et al. (2011), there are some historical aspects that add to the challenges (Le Fleur et al., 2014; SEDA SME Sector study, 2016). These historical challenges include:

1. **High levels of crime** – According to the SEDA SME Sector study (2016), South Africa's high level of crime is a pervasive problem. It was found that in 2015, South African SMMEs were forced by the security situation to increase spending on security, which then had a ripple effect on the overall cost of doing business.
2. **Onerous labour laws** – According to the SEDA SME Sector study (2016), South Africa's labour laws are a significant regulatory obstacle to business

growth, particularly when it comes to employee dismissal. SMME owners have found that once they have employed workers, the law makes it difficult to lay the workers off if the business can no longer afford to keep them or if they prove to be unproductive.

3. **Poor Infrastructure and service provision** – South Africa still suffers from an inadequate public transport system, congested roads, shortages in available operating space and service connectivity gaps (e.g. internet connectivity problem, water and electricity accessibility). Because of these issues, workers who use public transport tend to arrive late or do not pitch at all to work due to transport non-availability at times, resulting in low productivity.
4. **Apartheid legacy** – South Africa's history is such that, economic and educational empowerment was done according to racial profiling, limiting empowerment to less than 10% of the population while undersupplying the rest of the population. According to Berry et al. (2002), low levels of education and training among 90% of the population prior to 1994 have perpetuated suppression of entrepreneurial activities.

2.1.4 Conclusion

The significance of SMMEs regarding GDP and employment contribution to an economy is the bases why the researcher selected SMMEs for this research study.

2.2 Manufacturing

2.2.1 Introduction

This section focuses on the significance and context of manufacturing. Not all SMMEs are manufacturers and the researcher will establish the link between manufacturing and SMMEs.

2.2.2 Genesis of manufacturing

The word manufacturing has Latin roots; *manu,* meaning by hand, joined with *facere,* meaning to make (Wright, 2001). Manufacturing can be best thought of as the making of articles/goods by physical labour or machinery. For centuries, manufacturing was done by physical labour, in which a person with hand tools used craft skills to make objects. Ayres and Miller (1983) further defined manufacturing as the "confluence of the supply elements (such as the new

computer technologies) and the demand elements (the customer requirements of delivery, quality, and variety)". Manufacturing in today's world typically comprise machines, robots, computers and humans that all work in a specific way to create a product (Markus, 2017).

The above manufacturing approach, considering modern-day manufacturing, has its roots in the Industrial Revolution period of 1770 to 1820 (Schonberger, 1982). The Industrial Revolution was a transitional period from an old manufacturing approach that was primarily family/artisan-orientated where most families/artisans worked from their farms or homes producing goods using their hands and/or hand tools to a bigger scale of producing goods using machines. Historians have argued but failed to pinpoint a single reason for this revolution (Plumb, 1965; Wood, 1963). Most historians agree that the revolution was spurred by a combination of technological, economic, and political factors that are as follows (Wright, 2001):

1. A rapid increase in the daily health and living conditions of people;
2. Access to large markets, not only in England but across the globe;
3. A long period of social and political stability in Britain that provided the stage for a more entrepreneurial mood in business and commerce;
4. New techniques in banking and the handling of credit;
5. Many successive years of successful commerce, which caused capital to accumulate and interest rates to fall; and
6. James Watt's improved engine designs that made steam power usable by the industry.

A key feature of the Industrial Revolution was a shift from water to steam engine technology as a way to power production facilities. The history of modern-day manufacturing in South Africa can be traced to the early 1920s. Prior to that period, South Africa's economy was primarily focused on mining and agriculture, relying on imports from other countries for equipment inputs (Baker Baynes, 2017). Table 2.4 outlines four hundred years of global manufacturing development leading to the 21st century.

Table 2.4: Four Centuries of Manufacturing Leading to 21st Century Manufacturing

Manufacturing: Past, Present and Future

Early 18th Century	19th Century	20th Century	21st Century
• A person with an anvil and hammer • Poorly understood process • Craftspeople • Cottage industry	• Steam-powered machinery • Improved understanding of processes • Factory conditions in cities	• Computer-aided design, planning and manufacturing • Limited processes models using closed-loop control • Increased factory automation	• System-wide networks and information • Robust processes and intelligent control • Global enterprises and virtual manufacturing corporations

Source: Schonberger (1982

A modern-day manufacturing business typically falls under one of the following three categories (Markus, 2017):

1. **Make-to-stock** – Historical sales data is used to forecast future demand and plan the production activity in advance. Lead times tend to be shorter with make-to-stock manufacturing.
2. **Make-to-order** – The production process only starts after the order is received. Lead times tend to be longer when compared with make-to-stock, but the risk of excess inventory is eliminated.
3. **Make-to-assemble** – A strategy that relies on demand forecasts to stock the basic components of a product but starts assembling them after the order is received. It is a hybrid of MTS and MTO approaches.

The above definitions and background of manufacturing address one part of how to look at manufacturing. Roser (2016) calls this "how you produce something". Roser argued that beyond being concerned with how to produce something, one should also be concerned with

how items can be produced faster, better and cheaper. It is this latter view of manufacturing that delves into the concepts of the division of labour, Taylorism and Fordism.

2.2.2.1 Division of labour

The division of labour structures work through separation of tasks in a system so that participants can specialise (Silvermintz, 2010). Individuals are trained in specialised skills or trade to take advantage of the capabilities of others in addition to their own. The primary characteristic of the division of labour is specialisation and the separation of tasks.

Division of labour is generally traced back to Plato's time (from 427BCE to 347BCE). Plato argued for the division of labour in his Socratic dialogue book titled *The Republic*. *The Republic* focuses on the topic of justice (i.e. a just man or justice in a city-state). Silvermintz (2010), however, argued that although Plato recognised both the economic and political benefits of the division of labour, he ultimately critiques this form of economic arrangement, as it hinders the individual from ordering his own soul by cultivating acquisitive motives over prudence and reason. It is worthwhile noting that Plato's understanding of division of labour was to a degree influenced by Socrates' reference of Cephalus' armament factory, which was considered the only mass production operation of its kind in the ancient world (Glotz, 1926). It is generally accepted that Cephalus applied division of labour in his armament factory.

Other figures such as Duhamel du Monceau (1761), Graunt (1899), and Xenophon (Ambler, 2001) went on further to expand through their writings the division of labour concept. Smith (1776) further elaborated on the division of labour emphasising its quantitative importance on productivity improvement and adding a contradiction that sought to highlight the negative consequences of the division of labour, which ultimately focused on inadequate skilling of workers. Just like Smith, many individuals, including Karl Marx and Henry David Thoreau, that have criticised the effects of the division of labour on worker capabilities in relation to societal needs. Debates about the division of labour have continued to date with organisations, and more specifically, with management left to design division of labour in their organisations.

2.2.2.2 Taylorism

Taylorism, also referred to as scientific management, is a term widely used to describe a theory of operations management that analyses the way work is done with an objective of optimising worker productivity. The Taylorism term is taken from the founder of scientific management, Frederick Winslow Taylor. Much of Taylor's work was based on his factory experiences in the

period 1895 – 1911 working as a mechanical engineer, first at Midvale Steel Company and later at Bethlehem Steel Corporation (Hoffman, 2009).

Though Taylor is credited mainly for his work in establishing scientific management, he had two prior successes that are noteworthy (Wright, 2001):

1. He co-invented, together with Maunsel White, high-speed steel cutting tools that allowed a four times increase in cutting speed in the basic production processes of turning, drilling and milling.
2. He carefully analysed individual manufacturing processes such as metal machining and tried to bring them under closer control. The Taylor equation that relates cutting speed to tool life is still used today.

When Taylor turned his attention to factory organisation, he was concerned with understanding worker behaviour and how that could be addressed to improve labour productivity. The goal was to shorten each sub-task and get the overall task done more quickly. According to Taylor, people have a natural tendency to loaf. He called this human instinct to loaf, soldiering. Taylor embarked on experiments that ultimately produced an approach titled *Scientific Management*, published in 1910 (Taylor, 1910).

In *Scientific Management*, Taylor concluded that the duties of managers and workers would need to change considerably when compared to management approaches of pre-scientific management. Based on his understanding of worker behaviour, he grouped the duties of management into the following principles (Taylor, 1910):

1. Develop a science for each element of a person's work, which replaces the old rule-of-thumb method;
2. Scientifically select and then train, teach, and develop each worker, whereas, in the past, workers chose their own work and trained themselves as best they could;
3. Heartily cooperate with the workers to ensure all of the scientifically developed methods are being followed; and
4. There should be an almost equal division of work and a responsibility between management and workers. Management takes over all the work for which they are better fitted than the

worker, while in the past, almost all of the work and the greater part of the responsibility were thrown upon the workers.

Though Taylorism is credited with productivity improvements, there were drawbacks that led to its decline, these include:

1. monotonous work;
2. lack of autonomy;
3. labour union un-comfortability with time studies; and
4. grievances around worker pay

2.2.2.3 Fordism

Fordism is a term widely used to describe a manufacturing approach that led to the initial success of the Ford Motor Company. Though the Ford Company started producing cars in 1903, it was only in 1908 that Fordism came into being with the introduction of the Model T car (Doray, 1988). Fordism is designed to produce low-cost standardised products through a decently paid workforce that can also afford to buy the goods they are producing. Fordism expanded the division of labour principles and brought about maximum labour flexibility and adaptability to the manufacturing of goods.

A manufacturing plant that embraces Fordism would typically comprise of the following characteristics:

1. establishment of assembly lines;
2. standardisation of products to high tolerance;
3. high mechanisation or automation;
4. low emphasis on skills due to high mechanisation or automation; and
5. worker pay is significantly high (when compared to the industry norm).

It is normally argued that Fordism is a combination of the division of labour and Taylorism with a unique Ford contribution of moving assembly lines. Though Fordism came into being a few years after Taylorism, there are general disagreements on whether Ford's work was borrowed from Taylorism. Even with these disagreements on influence, Taylorism and Fordism are greatly credited with productivity improvements at the beginning of the 20th century. Hoffman (2009) noted that due to the influence of Fordism and Taylorism between

1919 – 1929, industrial output in the United States doubled as the number of industrial workers decreased.

It is also noted that even with the recorded successes of Fordism, draw-backs were experienced and these largely led to a decline in Fordism's influence. These drawbacks include:

1. labour unions' influence on worker productivity; and
2. production equipment and processes being vulnerable to worker sabotage.

2.2.3 Importance of manufacturing

In the nature of the manufacturing process, manufacturing businesses tend to be labour intensive and tend to hire more workers when measured as a ratio of turnover compared with non-manufacturing businesses. Similar to SMMEs, the most commonly used metrics for manufacturing contribution to the economy tend to fall into two categories:

1. employment contribution; and
2. GDP contribution

2.2.3.1 Manufacturing Employment Contribution

According to Mavlutova, Lesinskis and Olevskis (2017), employment is a multifaceted socio-economic phenomenon having a content, form, structure and organisation. According to the International Labour Organization resolution 7 (ILO, 2013), persons in employment are defined as all those of working age (i.e. 15 and older) who, during a short reference period, were involved in any activity of providing services or the production of goods for profit or pay. They comprise:

1. Employed persons "at work" (i.e. who worked for at least one hour);
2. Employed persons "not at work" due to temporary absence from a job, or to working-time arrangements (e.g. shift work, flexitime and compensatory leave for overtime); and
3. Self-employed (i.e. those whose remuneration depends directly on the expectation of profits derived from the goods and services produced and engage one or more persons to work for them as 'employees' continuously.

Mavlutova et al. (2017) noted that the manufacturing sector contributes significantly to global employment. The global number of people employed in the manufacturing industry increased by 43.4% in 2010 when compared to 1970 (refer to Table 2.5).

Table 2.5: Global Manufacturing Employment Contribution as a Share of GDP

Ranking (2010)	Country	The share of employment in the world			Growth rate
		1970	1990	2010	2010/1970
1	China	10,13	23,53	34,34	484,5
2	United States	13,03	9,71	6,36	69,8
3	India	3,4	3,98	5,88	251,1
4	Russia (USSR)	19,41	16,83	3,9	-
5	Brazil	1,48	2,32	3,84	366,7
6	Japan	7,79	6,2	3,63	67
7	Germany (FRG)	5,87	3,95	3,1	-
8	Bangladesh	0,15	0,57	2,53	2550
9	Vietnam	0,03	0,12	2,2	-
10	Indonesia	0,35	1,47	2,11	840
Number of employees in the world (millions of people)		139,7	180,3	200,3	143,4

Source: UNIDO (2013)

In South Africa, however, manufacturing employment figures, as a percentage of total employment, was ranked 4th. Table 2.6 provides the employment breakdown per industry.

Table 2.6: South African manufacturing employment contribution as a share of GDP

Industry	Dec 2014 ('000)	Dec 2015 ('000)	YoY Change (%)
Community and social services	3501	3624	3,5%
Trade	3247	3280	1%
Finance and other business services	2039	2273	11,5%

Manufacturing	1749	1738	-0,6%
Construction	1334	1438	7,8%
Private households	1219	1294	6,2%
Transport	952	900	-5,4%
Agriculture	742	860	16%
Mining	427	483	13,1%
Utilities	104	123	19,1%
Total	15314	16013	4,6%

Source: Stats SA (2016)

2.2.3.2 Manufacturing GDP Contribution

Kuznets (1966) set out to define six characteristics of modern economic growth in his Nobel memorial lecture in 1971. With a limited amount of quantitative information concerning growth before the mid-nineteenth century, Kuznets described long-term development patterns of countries based on empirical analyses of national accounts. He argued that industrialisation or increases in the share of manufacturing in GDP are a key feature of modern economic growth, which is markedly different from the pre-industrial revolution period which had lower growth rate.

It is also important to note Kaldor's examination of the relationship between industrial development and economic growth. Based on empirical results, he characterised the manufacturing sector as "the main engine of fast growth" (Haraguchi, 2015). This was found to be true for the 12 early industrialisers from the UK to Japan, and is also characteristic of catching-up countries that have experienced rapid, sustained growth.

Haraguchi (2015) argued that despite recent assertions of shrinking opportunities for manufacturing development in developing countries and a decrease in the importance of manufacturing for their economic development, there is no evidence to support that there is a manufacturing shrinkage. It is further noted that even after 1990, the manufacturing sector in developing countries still meets the conditions to be described as a driver of economic development, especially to achieve high sustained growth while retaining at least the same size in GDP and total employment as in the period from 1970 to 1990.

Rodseth (2016) noted that over the last 40 years, the South African GDP growth has mirrored manufacturing growth. Rodseth argued that the direct relationship between the two indicates the opportunity for manufacturing to become an engine rather than a mirror of GDP growth. In line with Rodseth's thinking, the Roosevelt Institute (2011) highlighted that manufacturing is fundamental to any economy with global trade being based on goods, not services. They argue that services are mostly the act of using manufactured goods, with 80% of world trade among regions being merchandise trade.

Langdon and Lehrman (2012) emphasised that beyond employment and GDP contributions, manufacturing businesses lead other non-manufacturing businesses on innovation, especially in the US. They attribute manufacturing's innovation contribution to its consistent investment to corporate R & D.

2.2.4 Challenges experienced by manufacturers and SMMMEs

Global manufacturing trends of the past 56 years indicate that even though the manufacturing output value for some countries (provided in Table 2.7) has increased between 1960 and 2016, some countries, including South Africa, have experienced a sharp decline in the manufacturing sector (World Bank, 2016). It is this decline in the South African manufacturing output that motivated the researcher to add the manufacturing dynamic in this study. The following table provides international comparisons of manufacturing output in US dollar terms and GDP contribution. It is evident from Table 2.7 that South Africa lags considerably when compared to its peers such as Turkey, Singapore and Malaysia.

Table 2.7: International comparisons of manufacturing output

Manufacturing Output ($ Billion)			Manufacturing Output (% of GDP)			
Country	**1960**	**2016**	**Country**	**1960**	**2016**	**Or**
Bangladesh	0.226	37	Bangladesh	5	18	↑
Brazil	3.85	181.8	Brazil	30	12	↓
France	13.8	250.8	France	-	11	↓
India	5.6	336.6	India	16	17	↑
Malaysia	0.197	66.02	Malaysia	10	22	↑
Singapore	0.074	54.5	Singapore	11	20	↑
South Africa	1.46	35.17	South Africa	20	13	↓
Turkey	1.8	143.4	Turkey	13	19	↑

United Kingdom	-	238.98	United Kingdom	-	10	⬇
Portugal	-	24.8	Portugal	-	14	⬇
Nigeria	-	35.12	Nigeria	-	9	⬇
Russia	-	158.6	Russia	-	14	⬇

- : No data available for that particular year

Source: World Bank (2016)

World Bank global ranking trends indicate that manufacturing output is still dominated by developed countries. Table 2.8 provides a list of the top 20 countries with the highest manufacturing output in US dollar terms.

Table 2.8: Top 20 ranking of manufacturing output

Rank	Country/Region	Manufacturing Output ($ Million)	Year
1	China	3,590,977.69	2017
2	Germany	759,904.17	2017
3	South Korea	422,064.51	2017
4	India	392,346.17	2017
5	Italy	284,296.97	2017
6	France	261,830.83	2017
7	United Kingdom	241,354.41	2017
8	Brazil	208,734.94	2017
9	Indonesia	204,726.20	2017
10	Mexico	198,452.70	2017
11	Russian Federation	188,013.13	2017
12	Spain	171,316.70	2017
13	Turkey	149,497.14	2017
14	Thailand	123,350.26	2017
15	Switzerland	123,184.32	2017
16	Poland	92,600.52	2017
17	Netherlands	88,817.03	2017
18	Saudi Arabia	88,366.93	2017
19	Argentina	82,817.67	2017
20	Australia	76,050.98	2017
33	South Africa	41,370.14	2017

Source: World Bank (2017)

It is clear from the above table that South Africa lags considerably from its peers such as Turkey and Mexico. The gap poses a significant opportunity to use manufacturing as an economic lever for the South African economy. Beyond the fact that developed economies dominate manufacturing output, global trends indicate that East Asian countries are next line regarding dominating the developing economies on manufacturing output. According to the United Nations Conference on Trade and Development (2016), of the eleven fastest growing non-island developing economies since 1980, nine are from East Asia.

In the South African context, Berry et al. (2002) identified SMMMEs in the clothing and furniture production as being labour-intensive and thus, more exposed to regulatory risk. Such SMMEs tend to experience high labour costs which are related or are a consequence of labour

laws that were meant to benefit workers. With SMMMEs finding it costly even to hire unskilled and semi-skilled workers, it adds to the hindrances of small business growth.

2.2.5 Conclusion

What is evident from the above sections of this chapter is the enormous scope for the growth of SMMMEs in South Africa and the opportunity they pose to turn-around the economic circumstances of the country with productivity improvements.

2.3 Lean Manufacturing

2.3.1 Introduction

This section focuses on lean manufacturing and its significance in business improvement.

2.3.2 Definition of Lean Manufacturing

The term Lean manufacturing was coined by WAYMO CEO, John Krafcik (1988) to describe the Toyota Production System (TPS). The term was popularised by Womack, Jones, Roos and Carpenter in their watershed book called *The machine that changed the world* (Womack et al., 1990). *The machine that changed the world* was a book about a $5 million, 5-year research study into Japanese automobile manufacturing practices (Womack et al., 1990). The research was housed by the International Motor Vehicle Program (IMVP) under the Massachusetts Institute of Technology (MIT). The study was motivated by a need to understand how American automotive companies could learn better manufacturing practices from Japanese automotive companies. It had been noted that the American way of manufacturing automobiles had not changed much since 1913 when Henry Ford adapted the conveyor belt to the manufacturing of cars (Basu & Wright, 2003).

Lean manufacturing can be described as a business philosophy that is concerned with maximising value for customers through the reduction of *muda* (waste). Shingo defined TPS/Lean as being 80% waste elimination, 15% production system and only 5% Kanban (1981). Shingo (1981) noted that about 80% of ordinary business people he interacted with tended to describe TPS as a Kanban system, while the other 15% tended to know how TPS functioned in the factory and would say, “it is a production system”. He finally noted that only a few (5% of ordinary business people he interacted with) really understood its purpose and would say, “it is a system for the absolute elimination of waste”. Lean is underpinned by

Industrial Engineering Techniques. The terms TPS and Lean Manufacturing are used interchangeably in this research document due to the background already provided above.

There are five steps to implementing Lean (Womack et al., 1990), namely:

1. identify value;
2. map the value stream;
3. create flow;
4. establish pull; and
5. seek perfection.

A key feature in lean is the obsession with optimising value-adding activities and reducing waste. Value-adding activities are loosely defined as those activities a customer is willing to pay for as they move the process closer to its end. Waste can be looked at as those activities that are not adding any value from a customer's perspective; they are a pure nuisance to employees (and often customers). The basic logic to waste elimination and TPS comes from Taylorism and the Gilbreths. Their methods can be described as follow (Shingo, 1988):

- Taylorism – defines the status quo analytically and temporally and improve it through scientific reasoning – these activities are known as time-study techniques.
- The Gilbreths – Frank B. Gilbreth and his wife Lilian, in the 1890s, developed a clearly-defined notion of improvement and established techniques to carry out an analysis by breaking up the status quo into elemental units of motion called Therbligs. Identify the purpose of each therblig and find the one best way (in which work is broken down, purposes are tracked down, and better methods are devised) using techniques that accord with those purposes.

The waste elimination concept is categorised into eight types of wastes. Former Toyota executive, Taiichi Ohno, identified the first seven types of wastes (Womack, 1993). It was not until 2004 that an eighth waste (non-utilisation of talent/people) was added by Michigan professor, Jeffrey Liker (2004). The eight types of waste including their description and examples are presented below in Table 2.9.

Table 2.9: Eight Wastes of Lean Manufacturing

Type of Waste	Description	Example
Defects or Errors	**Defects or Errors** refers to outputs that deviate from quality specifications and as a result are either scrapped, reworked or transferred to different streams	Scrap, rework, mistakes, concessions, transfers, incorrect collection of data, rejections in sourcing applications, incomplete PR's, bugs in IT development
Over production	**Overproduction** arises when we are applying resources to produce a product or service before it is needed by the next process, or generating more than is actually required	Running equipment to keep equipment and people busy, unbalanced work execution schedules, producing software features that nobody is going to use, information sent automatically even when not required, too many reviews
Waiting	**Waiting** involves delays to process steps and results in worker(s) having to wait for something or someone prior commencement of work. This may include waiting for information, authorization, tooling or approval.	Awaiting materials, awaiting people, awaiting equipment, awaiting process, awaiting authorization, system downtime
Non-utilization of people/talent	**Not fully utilized people/talent** represents under-utilization of people's skills set or potential. Because operators are close to their	Talents or skills not utilized, unbalanced workload, limited agility, inability to establish

	processes daily, they can often recognize problems or opportunities that staff or superiors just don't see, but the workers may never be asked for their input. They may also have other capabilities or formal skills that aren't formally part of their assigned jobs, but could be of use	preventative action(s) for root cause
Transport or Conveyance	**Transportation** or Conveyance waste deals with unnecessary movement of products or process inputs. From a customer perspective, transport/ conveyance adds NO value to the product. In fact, transportation/conveyance can sometimes even reduce value.	Long travel distances, routing of unnecessary approvals
Inventory or Queuing Waste	Products or work waiting in a queue are considered **inventory or Queuing** waste, as is excess stock in the form of raw materials, work-In-process and finished goods. In some cases, this waste may be the result of the waste of Overproduction	High obsolescence, packaging material that are excessively higher than replenishment point, excessive backlog of work to be processed
Motion	**Motion** waste involves movement by people. Poor ergonomics, leading to stretching, bending, twisting, walking creates motion waste	Repetitive/unnecessary movement caused by poor ergonomic design, looking for data & information, bending to pick items from the floor

Extra or over processing	**Extra or over processing** might be extra steps in a process or inefficient routings that may result in un-even cycle match. Organizations may want to provide the shiniest, most sparkly widget, but anything beyond a customer's spec is non-value-added	Lack of SOPs, incapable processes, too many approvals, multiple MIS reports

Source: The Toyota Way (2004)

In an attempt to help quantify the management policies of various plants across the world, Krafcik (1988) proposes the following characteristics as a way to think about production systems:

1. span of worker control;
2. inventory levels;
3. size of repair areas;
4. buffers; and
5. teamwork.

Presented below in Table 2.10 are comparisons into the characteristics of production systems from craftsmen period to Lean (Krafcik, 1988).

Table 2.10: Characteristics of production systems

Production System Characteristics				
	Craftsmen	**Pure Fordism**	**Recent Fordism**	**TPS/Lean**
Work Standardization	Low	High, by managers	High, by managers	High, by teams
Span of Control	Wide	Narrow	Narrow	Moderate
Inventories	Large	Moderate	Large	Small
Buffers	Large	Small	Large	Small
Repair Areas	Integral	Small	Large	Very small
Teamwork	Moderate	Low	Low	High

Source: Krafcik (1988)

2.3.3 Background to Lean Manufacturing

Understanding Lean Manufacturing requires some historical context of the Toyoda family business, as Lean was highly influenced by the founding members' beliefs and Japan's economic context. The Toyota group of companies were born from Toyoda Loom Works business that was founded in 1926 by a Japanese inventor, Sakichi Toyoda (Liker, 2004). Toyoda Loom Works is a corporation that is involved in activities that include automobile assembly and the manufacture of automobile components, industrial vehicles and textile machinery.

In the 1920s, Sakichi Toyoda invented a sophisticated automatic power loom. Years later, in 1929, Sakichi sent his son, Kiichiro Toyoda, to England to sell the patent rights to his mistake-proof power loom. The patent was sold for £100 000 to British textile maker, Platt Brothers (Liker, 2004). Sakichi took the £100 000 and started Toyota Motor Corp. and tasked Kiichiro with building the car business. After studying mechanical engineering and engine technology at the Tokyo Imperial University, Kiichiro built the company on his father's management approach but added his own innovations. The Toyota management approach to manufacturing is called the Toyota Production System (Liker, 2004).

There are two primary pillars to TPS and subsequently Lean, namely JIDOKA and Just-in-Time (JIT) (Ohno, 1988). Figure 2.2 illustrates how the TPS/Lean pillars interface with Toyota philosophies and desired outcomes.

Figure 2.2: TPS/Lean Model

Source: University of Kentucky – True Lean (2018)

The oldest part of TPS/Lean is the concept of Jidoka that was developed in the 1920s by Toyoda founder, Sakichi Toyoda, at his weaving and looming plant (Smalley, 2002). Jidoka is concerned with building in quality at the production process as well as enabling the separation of man and machine for multi-process handling. There are two parts to Jidoka: 1) Building in quality at the process, and 2) Enabling the separation of man from machine in work environments. Jidoka is a Japanese word that ordinarily means automatic or automation. Toyota, however, puts a specific twist on this word by adding what is known as a "radical" in depicting kanji characters (Smalley, 2002). "The radical added to the left of one of the kanji characters in Jidoka means human." In other words, Lean aspires for processes that can make intelligent decisions and shut down automatically at the first sign of an abnormal condition such as a defect or other problem. The goal is not to run continuously but to stop running automatically when trouble arises.

The second pillar of TPS/Lean is the JIT pillar of the production system. Kiichiro Toyoda coined the phrase Just-in-Time in 1937 after the start of Toyota Motor Corporation (Smalley, 2002). The company was poor and could not afford to waste money on excess equipment or materials in production. Everything was expected to be procured just in time and not too early or too late. The JIT concept aims to produce and deliver the right parts, in the right amount, at the right time using the minimum necessary resources. This system reduces inventory and strives to prevent both early and overproduction. Producing in a JIT fashion exposes problems quickly. Later elements developed in the 1950s including takt time, standardised work and Kanban added to the basis for JIT.

After World War II, Taiichi Ohno, an engineer in the Toyoda Spinning and Weaving Corporation, was brought over to the automotive side of the business. He was given the task of improving operational productivity and driving the concepts of JIT and Jidoka (Smalley, 2002). He was eventually appointed machine shop manager of an engine plant and experimented with many concepts in production between the years of 1945 and 1955. His work and effort largely resulted in the formulation of what is now acknowledged as the Toyota Production System. It was Ohno, guided by consultants and Engineers that include Edwards Deming, Joseph Juran, Shigeo Shingo and others, that contributed to the overall development of the company and the production system.

The original Toyota model of Lean Manufacturing, from which various hybrids were developed, comprised eight tools and approaches (Basu, 2003):

1. Total Productive Maintenance (TPM) – An approach to asset care or equipment maintenance that aims to improve productivity through equipment reliability. Overall Equipment Effectiveness (OEE) is a key metric in TPM.
2. Visual Workplace (5S') – 5S consists of 5 pillars that start with an "S" (Hirano, 1995). The 5 pillars are defined as Sort, Set in order, Shine, Standardise and Sustain. The objective of the 5S' is to expose defects visually to allow for the elimination of waste.
3. Just in Time (JIT) – JIT generally precludes large batch production; instead, items are made in batches of one, referred to as one-piece flow. One-piece flow's ultimate goal is to expose quality and cost
4. Single minute exchange of dies (SMED) – Achieving JIT requires using small-lot production employing SMED and dramatic reductions in lead times. SMED is aimed at reducing machine set-up time to single digit minutes (i.e. less than ten minutes).
5. Jidoka or Autonomation – Jidoka is anchored around the notion of building in quality at the production process as well as enabling the separation of man and machine for multi-process handling
6. Production work cells – A production logic that brings together people, equipment and processes into a single location. Work cells enable single-piece flow as there is minimal movement of the product and there are no redundant activities from cell to cell (Hennessey, 2017)

7. Kanban – Kanban means “tag” or “ticket” (Shingo, 1988). The Kanban system is used as a means of control and coordination.
8. Poka-Yoke (mistake-proofing) – Poka-yoke refers to a source inspection system that strives to achieve 100% inspection through mechanical or physical control (Shingo, 1986). There are two ways in which poka-yoke can be used to correct mistakes:
    a. Control type – when the poka-yoke is activated, the machine or processing line shuts down so the problem can be corrected.
    b. Warning type – when the poka-yoke is activated, a buzzer sounds or a lamp flashes to alert the worker.

Common techniques found in Lean manufacturing today include:

1. Just-in-time
2. SMED
3. Visual Management
4. 5S
5. PDCA cycle
6. 5-Why problem-solving (and the other 6 quality control tools)
7. Value-stream mapping
8. Standardised work
9. Eight wastes
10. Hoshin Kanri (policy deployment)
11. Total productive maintenance
12. Poka-Yoke

For this study, the above (12) techniques will all be considered as elements of Lean and companies will be measured against these techniques. Implementing Lean typically takes a number of years. McGivern and Stiber (2014) averaged the implementation period to 5 years and broke down activities as per Table 2.11.

Table 2.11: Lean implementation method and time period

	Years			
	0 - 0.5	**0.5 - 2**	**> 2 - 4**	**> 4**
Objective	*Building organisational awareness*	*Creating the new organisation*	*Aligning the systems*	*Completing the transformation*
Activities	1. Senior leadership clarifies the business case for Lean	1. Redesign the organisation to use Lean techniques	1. Continuous improvement processes are driven from bottom-up versus top-down	1. The transformation to Lean techniques is completed
	2. Management ensure Lean approach is consistent with organization's vision	2. Implement training and development processes to assist the transition	2. All organisational support systems are in alignment	2. Integration of Lean techniques with suppliers begins
	3. Management assesses the organization's readiness for Lean transition	3. Help leaders and employees make the transition to their new roles	3. Ongoing measurement and process monitoring systems are ingrained in the new culture	3. Ongoing continuous improvement and organisational development is a way of life
	4. Management defines the baseline measures of success		4. The bottom line is meeting the favourable expectations identified in the business case from the first six months	4. Savings in buffer length should be directly reflected in a reduction of building costs for the facility.
	5. Organization defines timelines consisting of communication, objectives and scope of implementation			5. A starting point to explore further the potential benefits that Six Sigma or Design for Six Sigma can have for process design, opening a

				promising line for further research
	6. The vision of the redesigned organization strongly supports the linkage of business strategy to cultural strategy			
	7. The vision of the redesign includes the alignment of the organization's communication, accountability, skills, processes and systems			

Source: McGivern and Stiber (2014)

2.3.4 Lean Manufacturing Beyond Toyota

Although Toyota pioneered most concepts that are considered to encompass Lean, it is worthwhile highlighting that some of these techniques are not unique to Toyota (Womack, 1993). Other Japanese firms also made dramatic improvements along a complementary path and from a different starting point. They made their improvements by extending the original statistical quality control concepts introduced by the Americans immediately after World War II to involve the shop floor in Quality Circles using the seven quality tools and Plan-Do-Check-Act (PDCA) cycle.

In the 1950s, more Japanese companies started experimenting with early forms of policy deployment and the management of quality improvement across each functional process. Over a few years, Total Quality Control (TQC) was widely applied across the industrial landscape in Japan. Toyota only began adopting TQC in the early 1960s in parallel with Taiichi Ohno's ideas of continuous flow (Womack, 1993). Womack et al. (1993) noted that Toyota's real advantage was that it alone could combine TQC with TPS to stand out from others. It was not

until the 1973 Japan energy crisis when most companies other than Toyota started losing money that the benefits of Toyota's Lean system became apparent. Companies such as Mitsubishi Motors, Mazda, Ford, Honda and other Japanese car companies adopted Toyota's principles with mixed results. Over time, the Toyota principles spread to America as a consequence of seeing Japanese products being sold in America at a price cheaper than what it was to make in America. The competitiveness of Japanese manufacturers resulted in media and academic research attention that include works by Schonberger (1982) and Womack et al. (1990).

2.3.5 Benefits of Lean Manufacturing

Lean is widely recognised as a productivity improvement technique because of proven and sustained results that Toyota has achieved over decades. Typical key performance areas that measure the success of Lean are Safety, Quality, Delivery, Cost and Morale (Sharma & Chikhalikar, 2015). Companies implementing Lean tend to measure the five (5) key performance areas and benchmark each other based on those KPAs.

Table 2.12 shows performance comparisons between three plants that applied mass production (General Motors in Framingham, USA) and Lean manufacturing (Toyota in Takaoka and NUMMI in Fremont). The results are an outcome of a research study by Krafcik (1988).

Table 2.12: Plant performance comparison, 1987

Plant performance survey, 1987	General Motors Framingham (Mass Producer)	Toyota Takaoka (Lean Manufacturing)	NUMMI Fremont (Lean Manufacturing)
Gross assembly hrs per car	40.7	18	-
Adjusted assembly hrs per car	31	16	19
Assembly defects per 100 cars	135	45	45
Assembly space per car	8,1	4,8	7
Average inventories of parts	2 weeks	2 hrs	2 days

Source: Womack (1990)

Further analysis from the same Krafcik study highlighted further productivity differences between plants that had implemented lean principles and those that did not. Table 2.13 and Figure 2.3 provide further data points.

Table 2.13: Plant performance comparison, 1987

Summary of assembly plant characteristics, 1989				
	Lean plants in Japan	**Lean plants in North America**	**Non-lean plants in North America**	**Non-lean plants in Europe**
Performance:				
Productivity (hrs/vehicle)	16,8	21,2	25,1	36,2
Quality (assembly defects/100 vehicles)	60	65	82,3	97
Layout:				
Space (sq. ft./vehicle/year)	5,7	9,1	7,8	7,8
Size of repair area (as % of assembly space)	4,1	4,9	12,9	14,4
Inventories (days for 8 sample parts)	0,2	1,6	2,9	2
Workforce:				
% of work force in teams	69,3	71,3	17,3	0,6
Job rotation (0 = none, 4 = frequent)	3	2,7	0,9	1,9
Suggestions/Employee	61,6	1,4	0,4	0,4
Number of job classes	11,9	8,7	67,1	14,8
Training of new production workers (hrs)	380,3	370	46,4	173,3
Absenteeism	5	4,8	11,7	12,1
Automation:				
Welding (% of direct steps)	86,2	85	76,2	76,6
Painting (% of direct steps)	54,6	40,7	33,6	38,2
Assembly (% of direct steps)	1,7	1,1	1,2	3,1

Source: Womack (1990)

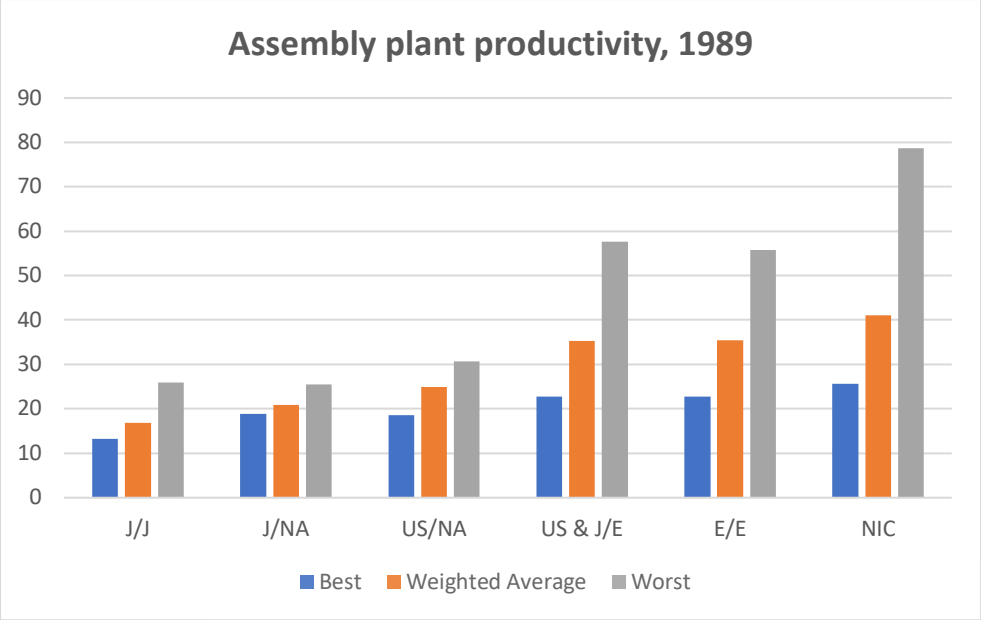

Figure 2.3: Assembly Plant Productivity

Source: Womack (1990)

Table 2.14: Abbreviations

Assembly plant productivity, 1989	Best	Weighted Average	Worst
J/J	13,2	16,8	25,9
J/NA	18,8	20,9	25,5
US/NA	18,6	24,9	30,7
US & J/E	22,8	35,3	57,6
E/E	22,8	35,5	55,7
NIC	25,7	41	78,7

J/J	Lean plants in Japan
J/NA	Lean plants in USA with Japanese managers/owners
US/NA	Lean plants in USA without Japanese managers/owners
US & J/E	Lean plants in Europe
E/E	Non-lean plants in Europe
NIC	Non-lean plants in newly industrializing countries: Mexico, Brazil, Taiwan & Korea

What is clearly evident when analysing the results presented by Krafcik (1988) is the consistent trends of better performance against any metric between Lean plants and non-Lean plants. Further studies, including a study by Moorthi (2008) highlighted the following benefits of implementing Lean:

1. More than 10% increase in direct labour utilisation
2. 50% reduction in inventory
3. 70% decrease in manufacturing cycle time
4. 50% increase in capacity on current machines
5. 90% reduction in lead time
6. 80% quality improvement
7. 75% reduction in space utilisation

Beyond Moorthi, Pitout (2006) highlighted significant benefits of implementing Lean in South Africa. Pitout conducted a study of two companies that implemented Lean in South Africa and documented their results. Table 2.15 presents Pitout's results.

Table 2.15: Benefits of implementing Lean

Measurement	Company A		Company B	
	Before Lean	After Lean	Before Lean	After Lean
OEE %		5% improvement	60%	65%
Customer Satisfaction Index		A Rating VDA		
Loss % (rejects)		30% improvement	20%	1%
Average Cycle Time		20% improvement		10% improvement
Delivery Performance		Improved efficiency by reduced labour	4700ppm	1500ppm
Average Changeover Time		N/A	90mins	60mins
Work in Progress		80% reduction on line	R500 000,00	R50 000,00
Stock on Hand		No change	1.8 days	0.8 days
Multi Skilling		10% improvement	No	Yes
Employee Suggestions	0	5		up 100%
Space Utilization		80% improvement		30% improvement

Source: Pitout (2006)

The benefits presented are primarily results from big companies. The researcher analysed other research looking at Lean implementations in SMMMEs and found similar benefits often found in bigger organisations. Pingyu and Yu (2010) found in the study of Lean Manufacturing in Wenzhou (China), that in some cases (before and after), measurements have been performed and the following Lean benefits were realised:

1. A decrease of work in progress (WIP) by 90% and finished goods inventory (FGI) by more than 50% through layout improvement and single minute exchange of dies (SMED) activities
2. Welding/assembly capacity increase by 50%
3. Forty-three per cent (43%) set-up time reduction through SMED
4. Decreased inventory level by two thirds

Rothenberg and Cost (2004), studying Lean implementation in printing SMEs, noted that these companies, just as their bigger counterparts, also realised productivity improvements through waste reduction efforts. The study highlighted that benefits often found in bigger companies can also be found in smaller companies.

2.3.6 Challenges experienced when implementing Lean Manufacturing

Lean manufacturing has proven a sustainable approach to productivity improvement and results have been widely documented and published. Even with all the results available, however, challenges to implementing the methodology remain. Some of these challenges according to Moorthi (2008) are:

1. The failure to convert the improvement to a monetary value, which links to the financial statements
2. Incorrect implementation procedure
3. The implementation on a difficult or low priority line that shows the complexity or is unable to show the actual benefits of Lean
4. Failure to introduce Lean implementation to supply chain
5. Failure to pursue Lean principles after the introduction
6. Failure of the company to adapt to change
7. Incorrect balance between training and implementing
8. Lack of understanding the reason for change
9. The use of Lean to promote downsizing of the workforce

10. Opposition from middle management
11. Poorly defined measuring systems that are unable to convey the benefits of Lean
12. Short-term versus long-term thinking
13. Inadequate union involvement
14. The lack of commitment and ability to implement Lean

Pingyu and Yu (2010), studying the impact of Lean at 100 SMEs in Wenzhou, China, found similar findings to Moorthi. The following challenges were noted:

1. Misunderstanding of Lean – Pingyu and Yu found the following misunderstandings:
    a. The implementation of Lean requires a large investment and is only suitable for large companies
    b. Lean is only suitable for specific industries
    c. Lean originated in Japan and is not suitable for other countries
2. Employees' resistance to Lean – Pingyu and Yu argue that as a major business reform, the implementation of Lean will face resistance from the natural habit of internal people in the company.
3. Implementing Lean mechanically without revision according to the environment of the company implementing – Pingyu and Yu note that Lean has gradually developed based on Toyota's specific environment, such as socio-economic and cultural backgrounds. Many SMEs implemented Lean as a particular technology without understanding its true meaning.

Emiliani (2017) argued that the biggest obstacle to Lean is executive resistance. He noted that it is widely acknowledged within the Lean community that there has been far less recognition and acceptance of Lean as a more effective system of management than was originally imagined. Emiliani further argued that senior management typically has multiple business improvement approaches that can be deployed with ease and quicker when compared with Lean. Table 2.16 highlights the different type of business improvement approaches available to senior management and the time they take to implement.

Table 2.16: Business Improvement approaches available for senior management

Method for improving business results	Degree of difficulty (10 = highest)	Time to implement (Years)
Layoffs	1	< 1
Hire new managers	1	< 1
Close facilities	1	< 1
Stock buy-backs	1	1 – 3
Acquisition	2	1 – 2
Merger	2	1 – 2
Divestiture/Spinoff	2	1
Change incentive compensation	1	< 1
Develop new products	2	1 – 2
Develop new markets	3	1 – 3
Discontinue products/services	1	< 1
Reduce/increase debt	1	< 1
Change accounting methods	2	1
Incorporate offshore (inversion)	2	1
Technology/automation/	1	1 – 2

digitization		
Consolidated operations	2	1 – 2
Outsource	2	1 – 2
Squeeze suppliers on prices	1	< 1
Price cuts/increases	1	< 1
Sales promotions	2	1
Patent term extension	2	1 – 2
Budget cuts	1	< 1
Seek lower taxes and less regulation	2	1 – 3
Lean manufacturing	6	> 5

Source: A study of executive resistance to Lean (2017)

Leite's (2016) findings summarised factors influencing Lean in Table 2.17.

Table 2.17: Barriers and enablers of Lean sustainability

	Organisational Elements	Barriers	Enablers	Sources
Technical Aspects	**Processes**	Demand uncertainty	Infrastructural elements	Doolen and Hacker (2005); Malmbrandt and Ahlstrom (2013)

		Supply chain characteristics	Matching demand and capacity levels	Al-balushi (2014); Portioli-Staudacher and Tantardini (2015)
		Weak supplier performance	Continuous improvement	Bortolotti et al. (2014); Zimmerman and Bollbach (2015)
	Technology and Tools	Lack of Lean experience	Visual information management system	Marodin et al. (2015); Wahab et al. (2013)
		Lean terminology	Measures and measurement systems	Bateman and Rich (2003); Brandao de Souza and Pidd (2011)
		Lack of consultants in the field	Process investigation (VSM)	Andersen and Rovik (2015); Mostafa et al. (2013)
	Training	Lack of Lean understanding	Training culture	Hilton and Sohal (2012); Bhasin (2013)

		Lack of people development	Personnel training and involvement in Lean principles and methods	Al-Balushi (2014); Poksinska (2010)
		Insufficient workforce implementation	Understanding of the Lean tools	Bhasin (2012); Mostafa et al. (2013)
	Resources	Lack of human resources	Dedicates full time resources for Lean	Marodin and Saurin (2015); Sisson and Elshennawy (2015)
		Financial resources constraints	Availability of resources	Bateman and Rich (2003); Radnor et al. (2006)
		Lack of time	Resources and capabilities	Mirzaei (2011); Pedersen and Rahbek (2011)
Cultural Aspects	**Strategy and Alignment**	Poor communication	Clear communication	Lucey et al. (2005); Radnor et al. (2006)
		Lack of strategy perspective	Clarity of vision	Bhasin (2013); Hines et al. (2004)

		Lean viewed as a Fed	Involvement of all parties (ownership)	Bhasin (2012); Lean Enterprise Institute (2007)
	Leadership	The lack of leadership team involvement	Top management support	Emiliani and Stec (2005); Massey and Williams (2005)
		Lack of employee empowerment	Leadership empowering the workforce	Dickson et al. (2009); Papadopoulou and Ozbayrak (2004)
		Managerial style	Management commitment (buy-in)	Portioli-Staudacher and Tantardini (2012); Radnor et al. (2006)
	Behaviour and Engagement	Lack of engagement	A culture that creates people involvement	Radnor and Walley (2008); Sisson and Elshennawy (2015)
		Resistance to change	Improvement culture	Albliwi et al. (2014); Dombrowski and Mielke (2014)

		Organizational culture and structure	Employee commitment (buy-in)	Malmbrandt and Ahlstrom (2013); Radnor and Boaden (2008)

Source: Leite (2016)

Pitout (2006) highlighted the following critical success factors that are required for the successful implementation of Lean:

1. Commitment from top management
2. Lean implementation project plan
3. Organisation-wide approach
4. The value of teams
5. Training
6. Communication strategy
7. Lean metrics

Pitout notes that the above critical success factors are instrumental in helping prospective Lean implementers understand the key elements of a successful implementation plan. Coetzee et al. (2016), in a separate study, argued that the continuous improvement of (CI)/respect-for-people relationship is largely ignored in many Lean implementation strategies. Coetzee et al. noted that "by concentrating on the tangible outcomes, organizations lose sight of the intangible aspects of change and culture, and in particular that companies are formed out of people".

2.4 Conclusion

Chapter 2 has outlined definitions, the background, benefits and challenges of SMMMEs and Lean Manufacturing as an improvement methodology. Considering the economic benefits of having a productive SMMME combined with the benefits of Lean, understanding the success rate of Lean in South African based SMMMEs and the role it can play in improving economic conditions of South Africa is crucial.

A number of reports, journals and articles referenced in the literature review highlight some of the success factors linked with SMMEs and Lean in general, but no published work could be

found on the success rate of Lean in SMMMEs. The present research aims to address that gap. Chapter 3 explores the research questions and hypotheses in detail.

Chapter 3: Research Problem Statement

Lean Manufacturing can be thought of as a deliberate way of thinking about customer value and how companies can deliver this value most efficiently. The outcomes of this study aimed to clarify the impact of lean manufacturing in South African SMMMEs.

3.1 Research Question

Based on the background provided above, the researcher intends to solve the following research problem: How well have South African SMMMEs used lean manufacturing to be operationally competitive and sustainable given its potential advantages of improving productivity (Womack et al., 1990).

Given the above research problem statement, the research question is as follows: How successful have Gauteng-based SMMMEs been in their lean manufacturing implementations?

Supporting the above research question are three research sub-questions:

How do Gauteng-based SMMMEs measure lean manufacturing success?
What are the pitfalls that characterise a Lean implementation outcome in an SMMME?
How sustainable were Lean implementation improvements in Gauteng-based SMMMEs?

3.2 Research Objectives

The research objectives are:

1. to establish a correlation between successful lean implementations and their impact on productivity metrics at Gauteng-based SMMMEs;
2. to quantify Lean implementation success rates among Gauteng-based SMMMEs;
3. to investigate factors that impact SMMME Lean implementation in the Gauteng Province; and
4. to conduct an explorative study among Gauteng-based SMMMEs that have implemented lean manufacturing.

3.3 Research Hypotheses

H_1: Lean implementation success rate among Gauteng-based SMMMEs is below 40%.

H_{01}: Lean implementation success rate among Gauteng-based SMMMEs is above 40%.

H_2: Lack of one or more of the following SMMME capability factors of management experience, Lean expertise, company culture, geographical location cultural influence, business needs, employee training, availability of financial and human resources will result in a failed Lean implementation.

H_{02}: Lack of one or more of the following SMMME capability factors of management experience, Lean expertise, company culture, geographical location cultural influence, business needs, employee training, availability of financial and human resources will not result in a failed Lean implementation.

Chapter 4: Research Methodology

4.1 Introduction

This chapter focuses on the methodology that was used to conduct the research and answer the research problem. The research methodology was formulated around five research objectives that exist as part of this study.

4.2 Research Method

The research method is structured in a mixed methods research design. Mixed methods research combines quantitative and qualitative research elements. The ultimate goal of mixed methods research "is to expand and strengthen a study's conclusions, thereby contributing to the published literature" (Schoonenboom & Johnson, 2017). Greene, Valery and Graham (1989) distinguished the following five purposes for mixing in mixed methods research:

1. Mixed methods better support corroboration of results from the different methods;
2. Complementarity outcomes better illustrate or clarify the results from one method with the results from the other method;
3. Results from one method help to develop or inform the other method;
4. Better understanding and/or discovery of contradiction or new perspectives coming out of results from one method with questions or results from the other method; and
5. Extend the breadth and range of inquiry by using different methods for different inquiry components.

Individually, qualitative and quantitative research methods have over time been criticised for lacking objectivity and generalisability (McKim, 2017). Mixed methods research has received good favour in literature because (McKim, 2017):

it combines the strengths of each methodology and minimises the weaknesses;
of the need to understand what information is encoded in a variable so the interpretation is meaningful;
it is critical in understanding complex phenomena because it allows readers to understand and explain;
it provides more breadth, depth, and richness as compared with either quantitative or qualitative methods alone; and

researchers have claimed mixed methods research provides a more balanced perspective and, therefore, is needed.

The quantitative approach of this research study was conducted using a survey questionnaire while the qualitative approach was conducted through interviews. The quantitative approach was used to present and analyse the close-ended questions while a qualitative approach was used to analyse the open-ended questions (Christodoulou, 2008).

This research aimed to understand the success rate of Lean implementations in South African SMMMEs and factors attributed to a successful or failed implementation. The study focused on multiple SMMMEs based in the Gauteng Province of South Africa.

The explorative nature of the research required an extensive literature review to contextualise key concepts and principles. The literature review then formed the bases for the development of a survey questionnaire that was used to gather quantitative data. Qualitative data were also collected using semi-structured interviews with identified members. Both survey questionnaire and interview schedules are attached as appendices (Appendix A) item for reference purposes.

4.3 Sampling

As previously indicated, this study focused on SMMMEs implementing Lean, but only those based in the Gauteng Province of South Africa. The rationale behind focusing on companies based in Gauteng Province is partly based on the concentration rate of SMMEs across the country. At the end of quarter two in 2015, Gauteng had the biggest share of SMMEs across the country at 34.87%, as per Table 4.1 (Stats SA, 2016).

Table 4.1: SMMEs by Province

Province	Total (Formal & Informal)	
Western Cape	230324	10,23%
Eastern Cape	197366	8,76%
Northern Cape	20611	0,92%
Free State	96846	4,30%
KwaZulu-Natal	373434	16,58%
North West	112856	5,01%
Gauteng	785321	34,87%
Mpumalanga	185399	8,23%
Limpopo	249663	11,09%
Total	2251820	100%

Source: Stats SA (2016)

The survey questionnaire was circulated to 80 companies in the Gauteng Province of South Africa. The method of communication was primarily through an e-mail distribution system. Because of e-mail access dynamics in SMMMEs, the target respondents were members of management starting at first line management to managing members/directors. The sample make-up is as follows:

Table 4.2: Breakdown of Sample Sub-sector

SMMME Sub-sector	Number of SMMEs in Sub-sector	Average Number of Employees	Municipality
Textiles	11	25	Johannesburg, Tshwane, Ekurhuleni, Emfuleni
Metal fabrication	8	70	Johannesburg, Tshwane, Ekurhuleni, Emfuleni
Plastics	12	35	Johannesburg, Tshwane, Ekurhuleni, Emfuleni
Packaging	11	65	Johannesburg, Tshwane, Ekurhuleni, Emfuleni
Security Accessories	8	12	Johannesburg, Tshwane, Ekurhuleni, Emfuleni
Semi-fabricated goods	9	45	Johannesburg, Tshwane, Ekurhuleni, Emfuleni
Furniture	10	80	Johannesburg, Tshwane, Ekurhuleni, Emfuleni

SMMME Sub-sector	Number of SMMEs in Sub-sector	Average Number of Employees	Municipality
General manufacturing	11	60	Johannesburg, Tshwane, Ekurhuleni, Emfuleni

Although Lean consists of many tools and techniques, only companies with the following tools and techniques were considered:

1. Just-in-time
2. SMED
3. Visual Management
4. 5S
5. PDCA cycle
6. 5-Why problem-solving (and the other 6 quality control tools)
7. Value-stream mapping
8. Standardized work
9. Eight wastes
10. Hoshin Kanri (policy deployment)
11. Total productive maintenance
12. Poka-Yoke

The above determination was informed by extensive document research that is captured in the literature review of this study.

Following Glaser and Straus' (1967) recommendation on the concept of saturation, in total, 32 quantitative responses were collated, supplemented by five (5) interviews in the qualitative analysis. The research investigation was done by comparing the conditions before and after Lean introduction.

4.4 Pilot study

A pilot study is a trial study conducted in preparation for a complete study. Because activities do not always work out as planned, the pilot study is used to test the research methodology, tools for data collection and assumptions to ensure the complete study achieves its objectives (De Vos, 2002). Its goal is to provide information that can contribute to the success of the research project as a whole. It can be considered as a try-out of research techniques and methods (i.e. the questionnaire and interviews in the context of this research study).

Welman and Kruger (1999) highlighted the following advantages of a pilot study:

1. It helps to clarify or identify unclear elements of the research method;
2. It helps detect possible flaws with the research method; and
3. It can highlight where the proposed method(s) are inappropriate or too complicated from analysing non-verbal behaviour of participants.

The selection criteria used for the sample selection of the pilot study followed the same criteria as that of the final study. Twelve companies (that constituted five companies from packaging, three companies from semi-fabrication and four companies from metal fabrication) were sampled. Of the twelve companies, five survey questionnaire responses were sent back to the researcher for analysis and one interview held. The outcomes of the pilot study left no outstanding issues with the research methods and found the research methodology tools adequate.

4.5 Data Collection Method

As previously indicated, two types of data collection methods were used. The initial target for data collection was small, medium and micro-manufacturing enterprises but this changed to small and medium-sized manufacturing enterprises due to difficulties in securing interviews and getting responses from micro-manufacturing enterprises. Data for microenterprises were not collected and not analysed in this study.

Because of the communication structure of most SMEs, in that its mostly managers who have access to emails, the targeted respondents for the quantitative study were directors, managing members, production managers, operations managers, foremen, supervisors, human resource

managers, finance managers and quality assurance managers. Questionnaires were sent to 80 companies with over 120 potential respondents. Of the 120 questionnaires that went out, only 32 responses were received.

The survey questionnaire approach had two advantages that were noticed:

1. The anonymity approach towards questionnaires made respondents more open to participating in the study and enhanced the reach on the number of responses when compared with the very few respondents that were willing to participate in interviews.
2. Costs associated with reaching out to questionnaire respondents were far less when compared to interviews.

The following disadvantages were noticed with the questionnaire method:

1. The researcher did not have control over the respondents' ability to respond. The respondent could choose to ignore a question/questions.
2. Lack of interaction resulted in responses that were not elaborated; thus, meaning clarification could not be provided.

Target respondents for interviews were primarily Lean project leaders. Project leaders typically have a holistic view of the implementation; hence, the reason for focusing the interviews on them. Semi-structured interviews were used to allow the interviewer the ability to probe the interviewee's knowledge and to increase control over data collection as compared to questionnaires because the language used in the interview can be adjusted to suit the respondent's needs or education level (Moorthi, 2008). Of the five (5) interviews, four (4) were direct personal interviews while the last one was a telephone interview.

4.6 Data Analysis

The data analysis was approached from the following points of view (Moorthi, 20018):

1. data preparation;
2. data exploring; and
3. examining, displaying and data mining.

All interviews were voice-recorded to ensure clarity in the interpretation of results. The interviews were structured around themes and the analysis was anchored around the same

themes. The themes included planning approach, change management, resource capability, ‘results achieved, sustainability and lessons for other companies embarking on the journey.

Quantitative data through a survey questionnaire were analysed using descriptive data and frequencies. Descriptive data refers to the description of the data being analysed while frequencies refer to the total number of variables or the number of times a component of a variable appears in a data set. Examples of descriptive data are as follows: Mean, standard deviation and median. Questionnaire responses with missing information greater than 10% are discounted and because of several interlinked variables in the questionnaire, multivariate analysis is used.

4.7 Limitations

The following limitations were identified during the study:

1. The focus on SMMMEs only based in Gauteng Province might be perceived unrepresentative of cultural and provincial dynamics that have an influence on Lean implementation outcomes. These dynamics include the quality of education of Gauteng residents versus their rural counterparts; Gauteng residents have access to better education and, therefore, have a business advantage of their rural counterparts. Another dynamic is access to broadband and information in general; Gauteng residents have an advantage over their rural counterparts on this topic. Further dynamics that give Gauteng residents an edge over their rural counterparts include road and rail infrastructure, better access to consulting support and a large economy.
2. The researcher’s inadequate budget to cover the other eight provinces of South Africa
3. The inability to sample and get data from micro enterprises
4. The unwillingness of SMMMEs to share financial records that would corroborate results

4.8 Conclusion

Chapter 4 has outlined the research methodology applied to obtain data relevant to the research objective. Chapter 5 presents the results of the quantitative study.

Chapter 5: Quantitative Results

5.1 Introduction

This chapter presents quantitative data results of survey questionnaire responses from 32 respondents. An initial 80 companies were identified, and of the 80 and over 120 questionnaires, 32 responded.

The survey questionnaire used to collect data was structured into 4 sections:

1. Section A: Organisational Profile
2. Section B: Planning and Change Management Phase
3. Section C: Lean Manufacturing Implementation Phase
4. Section D: Lean Manufacturing Assessment

5.2 Section A: Organisational Profile

Section A captures information relating to the make-up of the organisation, participants and the Lean programme deployed by the respondents. The nature of the data (i.e. categorical variables) is such that frequencies will be used to present the data (Pallant, 2007). Table 5.1 presents frequencies that formed section A1 (i.e. period in which the organisation has been in existence).

Table 5.1: Organisational Age

A1 Period/ How long has the organisation been in existence? (recorded)

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Up to 14 Years	15	46,9	46,9	46,9
	14 Years or More	17	53,1	53,1	100,0
	Total	32	100,0	100,0	

-

The period of existence of an SMMME is important because up to 80% of SMMEs fail in the 1first five years of their existence (The Small Enterprise Development Agency, 2018). The ratio of SMMMEs under 14 years and those older than 14 years was marginal. It could be concluded that the need to improve operational performance is as important to as below 14

years as it is to those above 14 years. This conclusion could be challenged in further studies with a bigger sample size.

Table 5.2 shows the positions held by respondents in SMMMEs that were sampled.

Table 5.2: Position in the Organisation

A2 Your position at the organisation?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Production Manager	8	25,0	25,0	25,0
	Operations Manager	8	25,0	25,0	50,0
	Quality Manager	4	12,5	12,5	62,5
	HR Manager	3	9,4	9,4	71,9
	Director	7	21,9	21,9	93,8
	Other	2	6,3	6,3	100,0
	Total	32	100,0	100,0	

A2 Other Please specify

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid		30	93,8	93,8	93,8
	Factory Manager	1	3,1	3,1	96,9
	Foreman	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

Table 5.2 captures the role profiles of respondents in the organisations they represent to contextualise the responses to that make-up. From the data set, there is a significant proportion of middle and senior management in the responses, thus, giving a perception of bias towards management's thinking as opposed to a combination of management and shop-floor employees. Focus for further studies would need to capture shop-floor insights to provide a balanced view and counter management bias.

Table 5.4 shows the role make-up of respondents regarding the Lean implementation within the organisation.

Table 5.3: Role in the Organisation

A3 Your role in the lean implementation process?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Steering Committee Leader	1	3,1	3,1	3,1
	Steering Committee Member	1	3,1	3,1	6,3
	Project Leader	20	62,5	62,5	68,8
	Project Sponsor	9	28,1	28,1	96,9
	Other	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

A3 Other Please specify

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid		31	96,9	96,9	96,9
	Senior Manager	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

From Table 5.3 when analysed in conjunction with Table 5.3 indicates that Lean deployment leaders in most SMMMEs tend to be dominated by middle and senior operations managers as opposed to support service managers. This provides an initial view that operations managers or manufacturing managers have identified a bigger need in Lean when compared to their support services counterparts.

Table 5.4 shows the years in which respondents have been employed by their organisations. Based on the spread of responses in Table 5.4, it can be concluded that the period of employment has no influence on an organisation's desire to implement Lean. This conclusion aligns with Table 2's conclusions in that, no matter the period of existence and length of employment, the desire for operational stability and productivity improvement applies to any organisation.

Table 5.4: Period in Operation

A4 Period/ how long you've been employed by the organisation?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Less than 5 Years	6	18,8	18,8	18,8
	5 to 10 Years	15	46,9	46,9	65,6
	10 to 15 Years	3	9,4	9,4	75,0
	15 to 20 Years	5	15,6	15,6	90,6
	More than 20 Years	3	9,4	9,4	100,0
	Total	32	100,0	100,0	

Table 5.5 shows the geographical spread of responding SMMMEs in Gauteng Province. Pretoria-based companies seemed more open to sharing their results than other regions of the province. This does not mean that Pretoria had more companies that implemented Lean than other regions do. The rate of implementation and difference among regions were not analysed, and this could possibly be part of the scope of a future study.

Table 5.5: Geographical Spread in Gauteng

A5 Geographical location of your organisation (Municipality)?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Tshwane	15	46,9	46,9	46,9
	Johannesburg	10	31,3	31,3	78,1
	Ekurhuleni	7	21,9	21,9	100,0
	Total	32	100,0	100,0	

A5Other Please specify

		Frequency	Per cent
Missing	System	32	100,0

Table 5.6 shows the main products manufactured by the responding SMMMEs. It is evident from the spread of the data that Lean implementations cut across different sub-sectors of manufacturing and that the need is not specific to one sub-sector. It can be concluded that no manufacturing sub-sector has a bias towards Lean.

Table 5.6: Organisation's Main Products

A6 Organisation main products?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Furniture	5	15,6	15,6	15,6
	Metal Fabrication	4	12,5	12,5	28,1
	Plastics	3	9,4	9,4	37,5
	Packaging Material	4	12,5	12,5	50,0
	Security Accessories	1	3,1	3,1	53,1
	Textile	2	6,3	6,3	59,4
	Other	13	40,6	40,6	100,0
	Total	32	100,0	100,0	

A6 Other Please specify

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid		19	59,4	59,4	59,4
	Canopy Production	2	6,3	6,3	65,6
	Crop Science	1	3,1	3,1	68,8
	Foundry Servicing	1	3,1	3,1	71,9
	Industrial Air Filters	1	3,1	3,1	75,0
	Industrial Chemicals	1	3,1	3,1	78,1
	Personal Care Products	2	6,3	6,3	84,4
	Small Scale Tractor Production	2	6,3	6,3	90,6
	Steel Metal Coating	2	6,3	6,3	96,9
	Steel Metal Slitting	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

Table 5.7 shows the number of employees from the responding SMMMEs. The researcher did not come across a micro-manufacturing enterprise that had implemented Lean. Because of the size and structure of micro-manufacturing enterprises, it can be concluded that implementing Lean in micro-manufacturing enterprises would be impractical, as the financial and human resource requirements are too much to absorb in those organisations. It can also be concluded that Lean is a more practical solution for small and medium-sized manufacturing enterprises.

Table 5.7: Number of Employees

A7 Number of employees?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	10 to 49	18	56,3	56,3	56,3
	50 to 249	14	43,8	43,8	100,0
	Total	32	100,0	100,0	

Table 5.8 shows the Lean approaches deployed by the responding SMMMEs. It can be seen from the responses that all the approaches deployed by respondents were outsourced, off the shelf programmes and that no internal programme was used. It does appear SMMMEs tend to not have enough expertise in-house to deploy a company-specific programme.

Table 5.8: Lean Approach Used by Respondents' Company

A8 Lean Manufacturing approach used by your company?

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Workplace challenge	7	21,9	21,9	21,9
	Mission Directed Work Teams	22	68,8	68,8	90,6
	20 Keys	2	6,3	6,3	96,9
	TRACC	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

A8Other Please specify

		Frequency	Per cent
Missing	System	32	100,0

Table 5.9 shows the length of Lean implementation per the responding SMMMEs. The data indicates that 71,9% of SMMME respondents did not implement a Lean programme beyond a two-year period. Because it takes a minimum of five years to implement an average Lean programme (McGivern, 2014), two years would not be enough time to entrench the culture of an organisation to the point of seeing the programme being sustainable. It can be concluded that only 28,1% of the respondents had a chance of sustaining their Lean programme.

Table 5.9: Length of Lean Implementation per Responding Company

A9 How long was the implementation phase of lean in your organisation? (recorded)					
		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	2 Years or less	23	71,9	71,9	71,9
	3 Years or more	9	28,1	28,1	100,0
	Total	32	100,0	100,0	

5.3 Section B: Planning and Change Management Phase

Section B captures information relating to planning and change management activities. It consists of five sub-sections that capture the following information:

1. The aims of the Lean implementation
2. The organisation's commitment to change management
3. Development of change management and Lean implementation plans
4. Internal skills capability within the organisation and external skills support
5. Budget availability

Table 5.10 outlines responses relating to the aims of implementing Lean among responses on a scale of 1 to 5 (1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree). It is evident from the data set that all respondents strongly identified Lean with productivity improvement more than any other aim.

Table 5.10: Aims of Implementing Lean

B1 What were the aim(s) of the lean implementation?

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
B1.1 Improve employee engagement	Count	0	0	2	9	21	32
	Row N %	0,0%	0,0%	6,3%	28,1%	65,6%	100,0%
B1.2 Achieve agile manufacturing	Count	0	0	0	13	19	32
	Row N %	0,0%	0,0%	0,0%	40,6%	59,4%	100,0%
B1.3 To drive customer focus/ centricity	Count	0	0	2	11	19	32
	Row N %	0,0%	0,0%	6,3%	34,4%	59,4%	100,0%
B1.4 Cost Reduction	Count	0	0	0	14	18	32
	Row N %	0,0%	0,0%	0,0%	43,8%	56,3%	100,0%
B1.5 Improve quality	Count	0	0	0	9	23	32
	Row N %	0,0%	0,0%	0,0%	28,1%	71,9%	100,0%
B1.6 Improve productivity	Count	0	0	0	0	32	32
	Row N %	0,0%	0,0%	0,0%	0,0%	100,0%	100,0%
B1.7 A stepping stone towards ISO quality certification	Count	0	0	4	9	19	32
	Row N %	0,0%	0,0%	12,5%	28,1%	59,4%	100,0%
B1.8 Other	Count	0	0	0	0	6	6
	Row N %	0,0%	0,0%	0,0%	0,0%	100,0%	100,0%

B1 Other Please specify

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid		28	87,5	87,5	87,5
	Achieve world class manufacturing operation	1	3,1	3,1	90,6
	Develop process ownership at shop-floor	1	3,1	3,1	93,8
	Improve Customer GMP Audit Performance from	1	3,1	3,1	96,9
	Part of business turn-around strategy	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

Because Lean focuses on the improvement of existing work methods, change management is critical in ensuring it is successful and sustainable. Table 5.11 presents participant responses when asked about the organisations' commitment to change management prior to implementation on a scale of 1 to 5 (1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree). There appears to be some awareness around change management although 87,5% of the respondents indicated that their organisations did not have an understanding of change management approaches. Leadership commitment appears to have been high when analysing the spread of responses. Leadership commitment is regarded as a far bigger requirement for the success of Lean than change management approaches, according to Emiliani (2017).

Table 5.11: Commitment to Change Management

B2 The organisation's commitment to change management process prior to implementation

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
B2.1 Your organisation has an understanding of change management approaches	Count	6	16	6	4	0	32
	Row N %	18,8%	50,0%	18,8%	12,5%	0,0%	100,0%
B2.2 There was executive or senior management team commitment towards lean implementation	Count	0	0	15	6	11	32
	Row N %	0,0%	0,0%	46,9%	18,8%	34,4%	100,0%
B2.3 There was executive or senior management sponsorship in the planning phase	Count	0	0	13	11	8	32
	Row N %	0,0%	0,0%	40,6%	34,4%	25,0%	100,0%

Table 5.12 presents participants' responses when asked about the organisation's change management and Lean implementation plans prior to implementation. A bigger portion of the respondents did not have change management and Lean plans drafted prior to implementation. These plans are crucial in directing an organisation towards the right efforts, and when plans are not in place, it will be less likely for an organisation to be successful in their endeavour. What was contrasting was the degree at which more respondents had steering committees

formed. It can be concluded that structured change management is not well understood and deployed in most SMMMEs and this can be linked to the success or lack thereof of some implementations.

Table 5.12: Change Management and Lean Implementation Plans Prior to Implementation

B3 Development of Change Management and Lean Implementation's Plans Prior to Implementation

		Yes	No	Total
B3.1 A change management plan was drafted before commencement of lean implementation	Count	14	18	32
	Row N %	43,8%	56,3%	100,0%
B3.2 There was a lean steering committee formed to drive lean implementation	Count	26	6	32
	Row N %	81,3%	18,8%	100,0%
B3.3 An all-inclusive lean project plan was developed with metrics for success clearly outlined	Count	15	17	32
	Row N %	46,9%	53,1%	100,0%

Table 5.13 presents participants' responses when asked about the organisation's skills availability prior to implementing Lean in their respective companies on a scale of 1 to 5 (1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree). It is evident that most respondents did not have prior Lean implementation experience and relied heavily on external resources to facilitate the implementation.

Table 5.13: Skills Availability

B4 Skills Availability within the Organisation

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
B4.1 The organisation had an internal resource who was afforded adequate time to guide the change management process	Count	0	8	9	13	2	32
	Row N %	0,0%	25,0%	28,1%	40,6%	6,3%	100,0%
B4.2 The organisation had an internal resource who was afforded adequate time to guide the lean implementation (from training to execution)	Count	0	6	9	13	4	32
	Row N %	0,0%	18,8%	28,1%	40,6%	12,5%	100,0%
B4.3 There were external resource(s)/ consultant(s) that were hired to help facilitate the implementation of lean in your organisation	Count	0	0	0	7	25	32
	Row N %	0,0%	0,0%	0,0%	21,9%	78,1%	100,0%
B4.4 The implementations team/ leader had implemented the approach at least once at another organisation prior to your organisation's implementation	Count	17	0	4	4	7	32
	Row N %	53,1%	0,0%	12,5%	12,5%	21,9%	100,0%

Because all the respondents had external resources to facilitate the implementation, understanding whether the respondents had a budget to support this need prior to implementation is critical. Table 5.14 presents participants' responses when asked about their company's budget availability prior to their Lean implementation. It is clearly evident from Table 5.14 that budget allocation prior to implementation took place.

Table 5.14: Budget Availability Prior to Implementation

B5.1 There was a budget determined for lean prior to implementation

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Yes	32	100,0	100,0	100,0

Table 5.15 presents participants' responses when asked about the organisation's budget availability during Lean implementation in their respective companies on a scale of 1 to 5 (1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree). It is evident from Table 5.15 that, although all the respondents had a budget allocated for the project, budget adequacy and funds availability seemed to be questionable at times.

Table 5.15: Budget Availability During Lean Implementation

B6 Budget Availability within the Organisation

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
B6.1 The budget adequately catered for all planned activities	Count	0	15	2	8	7	32
	Row N %	0,0%	46,9%	6,3%	25,0%	21,9%	100,0%
B6.2 Funds were made available when a justified request was made to implement something that would realize an improvement	Count	0	9	8	10	5	32
	Row N %	0,0%	28,1%	25,0%	31,3%	15,6%	100,0%

5.4 Section C: Lean Manufacturing Implementation Phase

Section C captures information relating to the actual implementation of Lean by surveyed companies. It consists of three sub-sections that capture the following information:

1. The types of Lean tools/techniques on which the organisation was trained
2. The frequency of use of the Lean tools/techniques on which the organisation received training
3. Lean implementation approach

Table 5.16 presents participants' responses when asked about Lean tools and techniques on which their respective organisations received training. Because not all companies are trained on the same tools in the same sequence, understanding the most common tools on which companies are trained is crucial in understanding the differences between the South African based Lean approach when compared to international Lean training approaches. It is evident that visual management and 5S are common tools of the South African toolkit.

Table 5.16: Lean Tools and Techniques on Which the Organisation was Trained

C1 Which of the Following Lean Tools and Techniques was your Organisation Trained on?

		Yes	No	Total
C1.1 Value Stream Mapping	Count	11	21	32
	Row N %	34,4%	65,6%	100,0%
C1.2 Visual Management (of Safety, Quality, Delivery/ Speed, Cost, & Morale/ People)	Count	32	0	32
	Row N %	100,0%	0,0%	100,0%
C1.3 A3 Thinking	Count	4	28	32
	Row N %	12,5%	87,5%	100,0%
C1.4 Standardized work	Count	24	8	32
	Row N %	75,0%	25,0%	100,0%
C1.5 7 QC Tools	Count	25	7	32
	Row N %	78,1%	21,9%	100,0%
C1.6 5S (Workplace Orderliness)	Count	32	0	32
	Row N %	100,0%	0,0%	100,0%
C1.7 Autonomous Maintenance	Count	2	30	32
	Row N %	6,3%	93,8%	100,0%
C1.8 Overall Equipment Effectiveness	Count	11	21	32
	Row N %	34,4%	65,6%	100,0%
C1.9 SMED	Count	3	29	32
	Row N %	9,4%	90,6%	100,0%
C1.10 Total Productive Maintenance	Count	0	32	32
	Row N %	0,0%	100,0%	100,0%
C1.11 Kanban or JIT	Count	14	18	32
	Row N %	43,8%	56,3%	100,0%
C1.12 7 Wastes	Count	23	9	32
	Row N %	71,9%	28,1%	100,0%
C1.13 Hoshin Kanri	Count	1	31	32
	Row N %	3,1%	96,9%	100,0%
C1.14 Poka Yoke	Count	8	24	32
	Row N %	25,0%	75,0%	100,0%
C1.15 Other	Count	7	25	32
	Row N %	21,9%	78,1%	100,0%

C1 Other Please specify

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid		25	78,1	78,1	78,1
	Team Work	7	21,9	21,9	100,0
	Total	32	100,0	100,0	

Beyond understanding the common tools of the toolbox, understanding how well the tools are used during implementation is another important point in understanding the key attributes of success. Table 5.17 presents participants' responses when asked about the organisation's frequency of use of Lean tools and techniques during implementation on a scale of 1 to 5 (1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always).

Table 5.17: Lean Tools and Techniques Frequency of Use

C2 How Often were the Following Tools and Techniques used during the Lean Implementation Phase?

		Never	Rarely	Sometimes	Often	Always	Total
C2.1 Value Stream Mapping	Count	21	4	4	2	1	32
	Row N %	65,6%	12,5%	12,5%	6,3%	3,1%	100,0%
C2.2 Visual Management (of Safety, Quality, Delivery/ Speed, Cost, & Morale/ People)	Count	0	0	1	14	17	32
	Row N %	0,0%	0,0%	3,1%	43,8%	53,1%	100,0%
C2.3 A3 Thinking	Count	28	0	2	0	2	32
	Row N %	87,5%	0,0%	6,3%	0,0%	6,3%	100,0%
C2.4 Standardized work	Count	9	6	5	7	5	32
	Row N %	28,1%	18,8%	15,6%	21,9%	15,6%	100,0%
C2.5 7 QC Tools	Count	7	8	12	2	3	32
	Row N %	21,9%	25,0%	37,5%	6,3%	9,4%	100,0%
C2.6 5S (Workplace Orderliness)	Count	0	0	3	10	19	32
	Row N %	0,0%	0,0%	9,4%	31,3%	59,4%	100,0%
C2.7 Autonomous Maintenance	Count	30	0	0	2	0	32
	Row N %	93,8%	0,0%	0,0%	6,3%	0,0%	100,0%
C2.8 Overall Equipment Effectiveness	Count	21	2	4	0	5	32
	Row N %	65,6%	6,3%	12,5%	0,0%	15,6%	100,0%
C2.9 SMED	Count	30	2	0	0	0	32
	Row N %	93,8%	6,3%	0,0%	0,0%	0,0%	100,0%
	Count	32	0	0	0	0	32

C2.10 Total Productive Maintenance	Row N %	100,0%	0,0%	0,0%	0,0%	0,0%	100,0%
C2.11 Kanban or JIT	Count	18	7	4	0	3	32
	Row N %	56,3%	21,9%	12,5%	0,0%	9,4%	100,0%
C2.12 7 Wastes	Count	9	0	15	5	3	32
	Row N %	28,1%	0,0%	46,9%	15,6%	9,4%	100,0%
C2.13 Hoshin Kanri	Count	31	0	0	0	1	32
	Row N %	96,9%	0,0%	0,0%	0,0%	3,1%	100,0%
C2.14 Poka Yoke	Count	24	0	6	2	0	32
	Row N %	75,0%	0,0%	18,8%	6,3%	0,0%	100,0%
C2.15 Other	Count	26	0	3	2	1	32
	Row N %	81,3%	0,0%	9,4%	6,3%	3,1%	100,0%

Beyond understanding how well tools are implemented, understanding the deployment approach helps to contextualise how Lean was operationalised in respondents' companies. Table 5.18 presents participants' responses when asked about their organisation's approach to implementing Lean.

Table 5.18: Organisation's Approach to Implementing Lean

C3 Implementation Approach of Lean in your Organisation

		Yes	No	Total
C3.1 The implementation approach started with a pilot area before rolling out to other parts of the organisation	Count	6	26	32
	Row N %	18,8%	81,3%	100,0%
C3.2 The entire organisation ultimately implemented	Count	31	1	32
	Row N %	96,9%	3,1%	100,0%
C3.3 The lean approach was an off the shelf package that was not customized to organisational pre-disposition (i.e. terminology, examples etc.)	Count	30	2	32
	Row N %	93,8%	6,3%	100,0%
C3.4 There was a recognition system that was set-up during lean implementation	Count	24	8	32
	Row N %	75,0%	25,0%	100,0%
C3.5 There was an emphasis in creating employee ownership when implementing actual lean concepts at different levels of the organisation	Count	32	0	32
	Row N %	100,0%	0,0%	100,0%

5.5 Section D: Lean Manufacturing Assessment

Section D captures information relating to how well the surveyed companies implemented Lean. It also consists of three sub-sections that capture the following information:

1. Adherence to Change Management structure
2. Adherence to Change Management and Lean plan
3. Success rate and sustainability of Lean

Table 5.19 presents participants' responses when asked about their organisations' governance structure and review approach. It is evident that most respondents had governance structures in place and a routine to review implementation and management of change.

Table 5.19: Lean Implementation Governance Structure and Review

D1 How Well did your Organisation Follow the Implementation Approach and Plan?

		Yes	No	Total
D1.1 A Steering committee governance structure existed to manage implementation progress against the plan	Count	28	4	32
	Row N %	87,5%	12,5%	100,0%
D1.2 Change management issues formed part of the steering committee governance structure	Count	28	4	32
	Row N %	87,5%	12,5%	100,0%
D1.3 There was a structured implementation review mechanism that reviewed implementation progress at agreed intervals in your organisation	Count	21	11	32
	Row N %	65,6%	34,4%	100,0%

Table 5.20 presents participants' responses when asked about their organisations' execution of Lean plan on a scale of 1 to 5 (1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always). What is evident from the data spread is the inconsistencies in adhering to implementation requirements. Most activities occurred sometimes as opposed to often or always as would be the expectation when rolling out a change programme.

Table 5.20: Lean Implementation Against Plan

D2 How Well did your Organisation Follow the Implementation Approach and Plan?

		Never	Rarely	Sometimes	Often	Always	Total
D2.1 There was adherence to steering committee meetings and actions	Count	4	6	12	6	4	32
	Row N %	12,5%	18,8%	37,5%	18,8%	12,5%	100,0%
D2.2 Implementation status formed part of senior management meeting(s)	Count	0	5	10	9	8	32
	Row N %	0,0%	15,6%	31,3%	28,1%	25,0%	100,0%
D2.3 Periodic recognition sessions were held with teams	Count	0	8	9	8	7	32
	Row N %	0,0%	25,0%	28,1%	25,0%	21,9%	100,0%
D2.4 There was management involvement in coaching teams towards understanding of lean tools and techniques	Count	0	10	11	9	2	32
	Row N %	0,0%	31,3%	34,4%	28,1%	6,3%	100,0%
D2.5 Periodic progress reports were distributed and discussed with all key stakeholder	Count	0	9	12	7	4	32
	Row N %	0,0%	28,1%	37,5%	21,9%	12,5%	100,0%

Table 5.21 presents participants' responses relating to their Lean implementation outcomes. The results show that most respondents agreed that their implementations were a success although only a fraction agreed that the success was sustainable.

Table 5.21: Lean Implementation Outcomes

D3 What did your Organisation Achieve using the Lean Approach?

		Agree	Disagree	Total
D3.1 The focus areas of Safety, Quality, Delivery/ Speed, Cost & Morale/ People measure productivity improvement in your organisation	Count	32	0	32
	Row N %	100,0%	0,0%	100,0%
D3.2 There was improvement of Safety, Quality, Delivery/ Speed, Cost & Morale/ People after lean implementation as compared to before lean	Count	22	10	32
	Row N %	68,8%	31,3%	100,0%
D3.3 Your organisation was able to directly link productivity improvements achieved with lean tools & techniques	Count	20	12	32
	Row N %	62,5%	37,5%	100,0%
D3.4 The change management process made a difference to the lean implementation outcome	Count	16	16	32
	Row N %	50,0%	50,0%	100,0%
D3.5 Your organisation's lean aim(s) were realized	Count	18	14	32
	Row N %	56,3%	43,8%	100,0%
D3.6 Lean implementation has been a success in your organisation	Count	20	12	32
	Row N %	62,5%	37,5%	100,0%
D3.7 Lean tools & techniques have been sustainable	Count	10	22	32
	Row N %	31,3%	68,8%	100,0%

5.6 Research Question and Sub-question 1

In the context of this study, productivity is regarded as a key Lean success metric because of the direct impact it has on the economy. When respondents were asked about their aims for implementing Lean, all 32 respondents chose productivity improvement as a minimum aim. When further asked if the focus areas of Safety, Quality, Delivery/Speed, Cost and Morale accurately measured productivity, all 32 respondents agreed, as can been seen in Table 21 (D3.1).

When a comparison was done between companies that used Safety, Quality, Delivery/Speed, Cost and Morale as a measure of productivity and those that realised the improvement of Safety, Quality, Delivery/Speed, Cost and Morale, 68.75% of the respondents were successful in their Lean implementation because the same 68.75% had realised productivity improvement through the improvement of Safety, Quality, Delivery/Speed, Cost and Morale. Figure 5.1 shows the graphical illustration of the comparison.

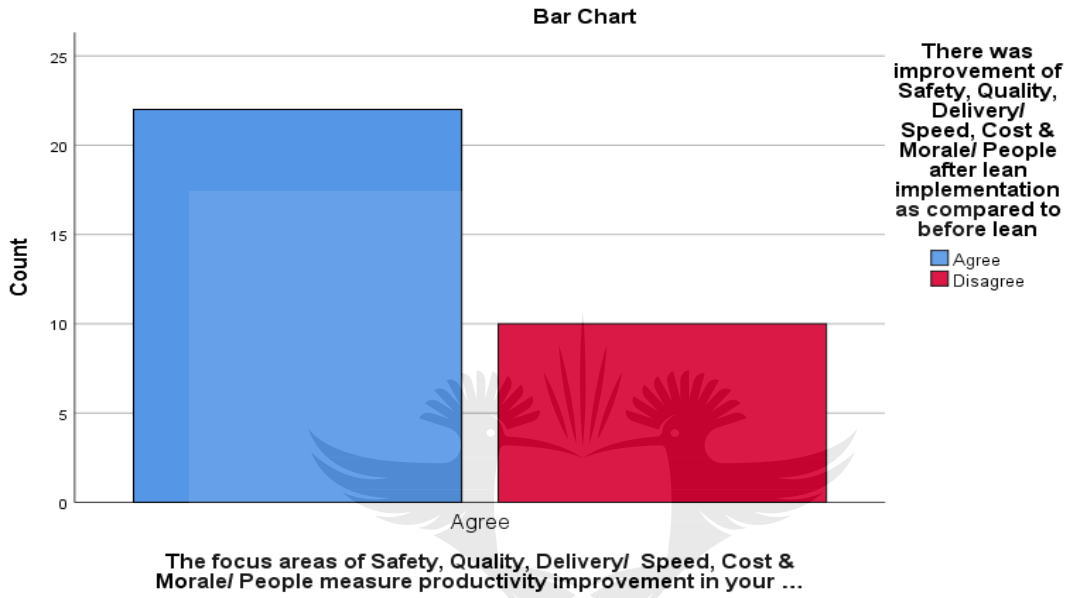

Figure 5.1: Productivity Improvement Comparison

Furthermore, Table 21 (D3.6) showed responses relating to the success of Lean among respondents; 62.5% indicated that their Lean implementation had been successful as opposed to 68.75% that had realised their productivity aim. The difference between the 68.75% and 62.5% can be attributed to some respondents having more than the one aim of improving productivity, as can be seen in Figure 5.1.

When further comparison was made on the success of Lean implementations regarding the size of the organisation, it is evident in Figure 5.2 that medium-sized manufacturing enterprises (those employing 50 to 249 employees) had a greater success rate when compared to small-sized manufacturing enterprises (those employing 10 to 49 employees). Of the medium-sized manufacturing enterprises, 78.6% were successful in their implementation as opposed to a 50% success rate for small-sized manufacturing enterprises.

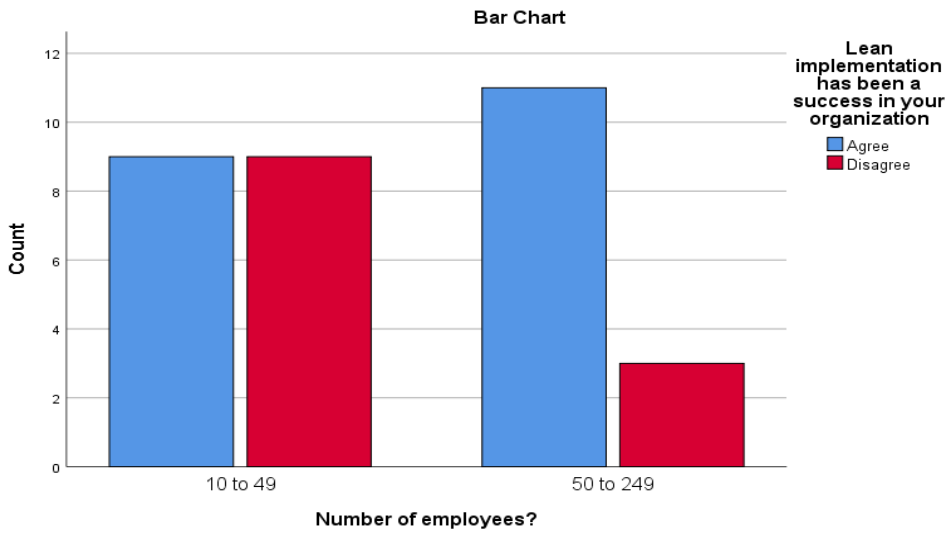

Figure 5.2: Company Size vs Success Rate

Medium-sized enterprises employ more people than small or micro enterprises and typically, at a higher rate than smaller enterprises, resulting in them being able to attract better-skilled resources when compared with small or micro enterprises. Figure 5.3 shows that medium-sized manufacturing enterprises have 30% better Lean experience when compared with small-sized manufacturing enterprises. This finding supports one of Pay's (2008) four reasons for why Lean projects succeed or fail, namely skills and expertise of resources.

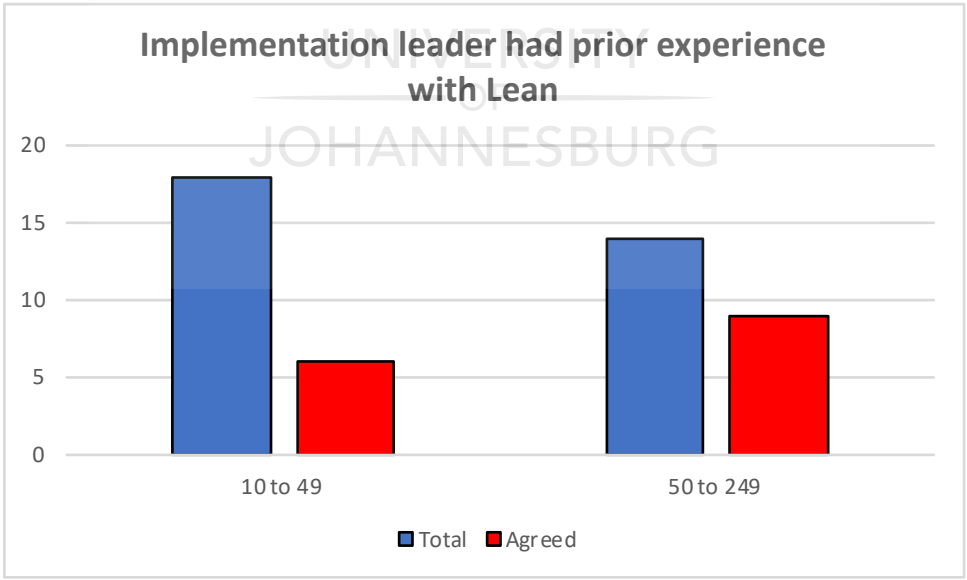

Figure 5.3: Skills & Expertise of Resources

Overall, from the findings of this research within the selected SMMMEs and in conjunction with the literature review, one can deduce that in the context of productivity and company-specific aims, lean manufacturing implementations have been more successful among South

African medium-sized manufacturing enterprises, with a greater than 60% success rate. The findings of this research are also in line with literature by Hu (2015) that indicate that the size of an SMMME does impact its ability to implement Lean even though there are other factors that are in favour of SMMMEs when implementing Lean. Further literature reviewed also confirms that Safety, Quality, Delivery/Speed, Cost and Morale metrics are considered benchmark metrics for measuring Lean (Sharma & Chikhalikar, 2015). Because of the small sample size, a larger sample size could have provided an even better outcome, but the theory is in line with this study's outcome.

5.7 Research Sub-question 2

This research question is aimed at understanding the factors associated with a Lean implementation outcome. As mentioned in the previous section (section 5.6), business skills and Lean expertise of resources in the organisation and of those guiding the organisation are critical in driving a good outcome. It does appear that the more experienced resource(s) an organisation has, the better the outcome. This is further supported in Figure 5.4. The data set confirms that responses that had internal skills capability stood a far better chance of realising success in their implementation when compared to those that were unsuccessful.

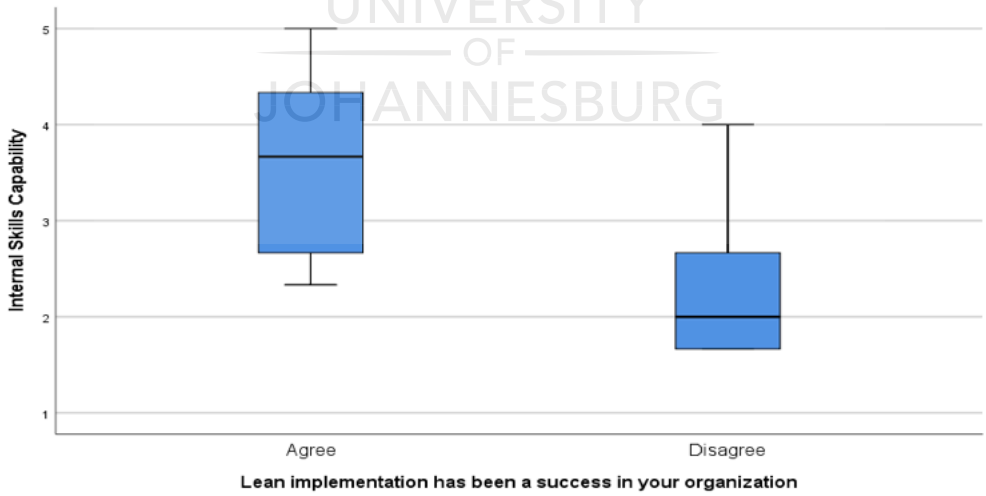

Figure 5.4: Impact of Internal Skills Capability on Success Rate

Another key factor is change management that is linked to a company's culture. Aguirre, Von Post and Alper (2013) found that the least successful change initiatives tended to not even consider culture and that more successful change initiatives leveraged cultural strengths to

support them. Respondents that embraced change management were found to have better success than those that did not embrace change management. Figure 5.5 shows that out of 20 respondents that embraced change management, only four were unsuccessful as opposed to 12 respondents that did not embrace change management and all 12 were unsuccessful.

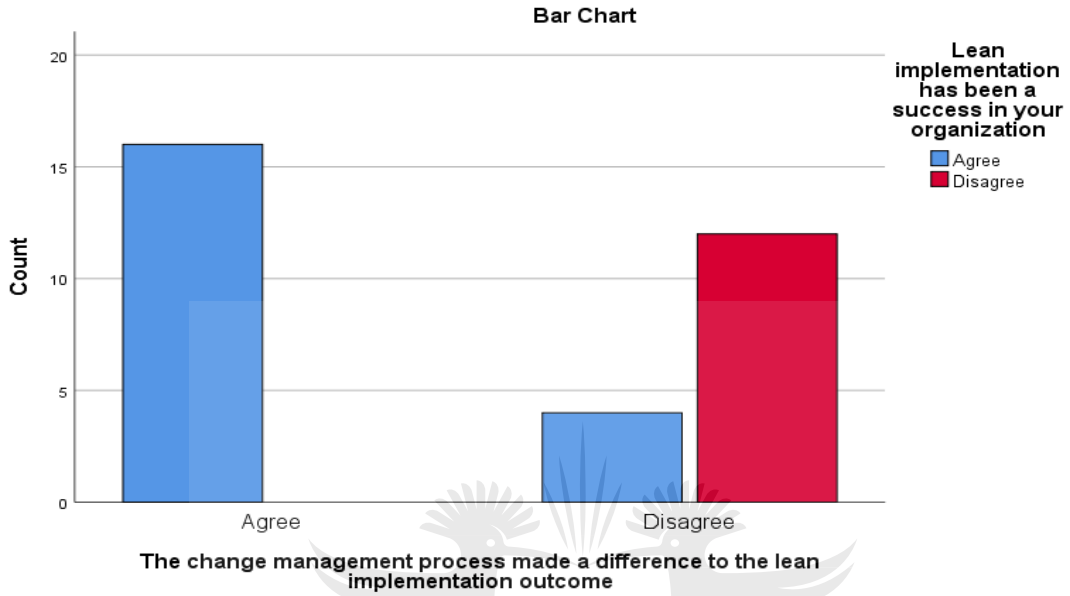

Figure 5.5: Change Management vs Success Rate

Furthermore, though all of the 32 respondents had a Lean budget prior to implementation, some agreed that the budget they had to implement Lean was inadequate. It appears that although an adequate budget can strengthen an implementation, it clearly is not enough by itself to make or break an implementation. Figure 5.6 shows that out of 14 respondents that had an adequate budget to execute planned activities, 20 implementations were successful while out of 12 unsuccessful implementations, 7 had an inadequate budget. It appears the key is to have a budget of some sort even though it might not be adequate.

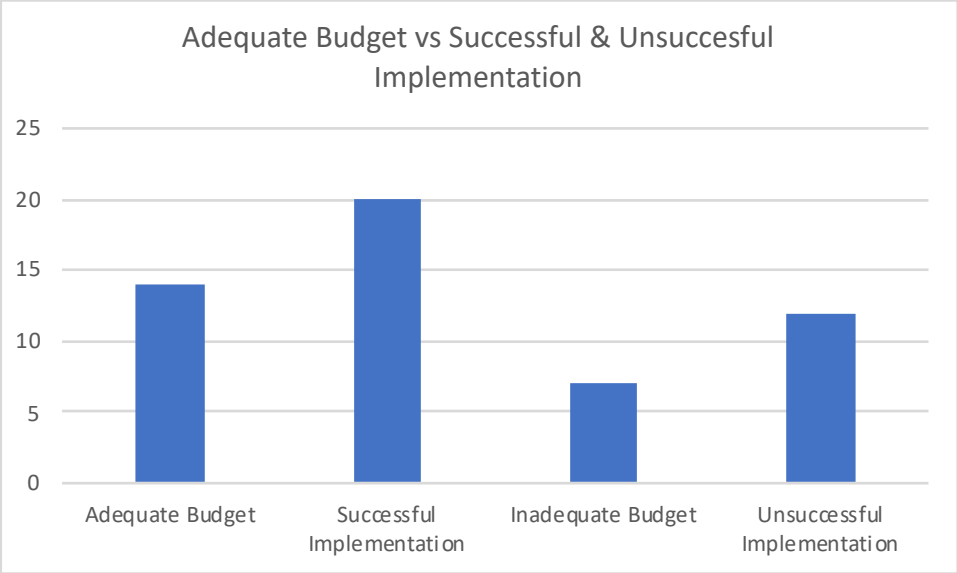

Figure 5.6: Budget vs Success Rate

5.8 Research Sub-question 3

This research question is aimed at understanding the sustainability of Lean implementations. Table 21 (D3.7) shows that only 31% of the respondents agreed that their Lean implementation had been sustainable. It is evident that although more respondents had agreed that their implementation of Lean had been a success, only a fraction of those believe it had been sustainable.

Figure 5.7 shows Lean sustainability between small and medium enterprises. It appears the size of an organisation does not drive better sustainability by itself. Both small and medium enterprises realised a mixed set of sustainability results.

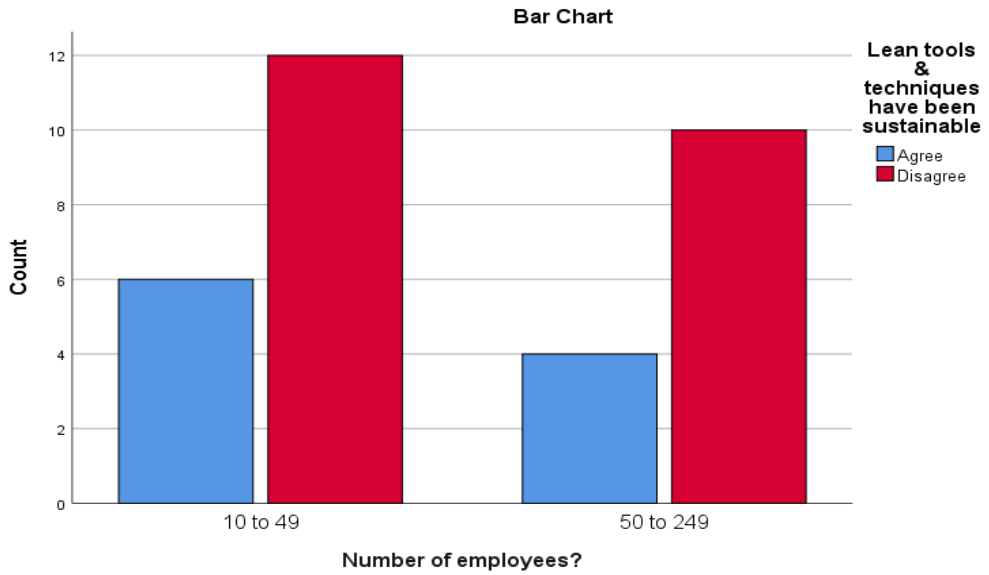

Figure 5.7: Sustainability in Relation to Size of the Organisation

Further analysis highlights that companies that agreed that change management made a difference in their Lean implementation had a better chance of sustaining their Lean implementation. Figure 5.8 illustrates the comparison.

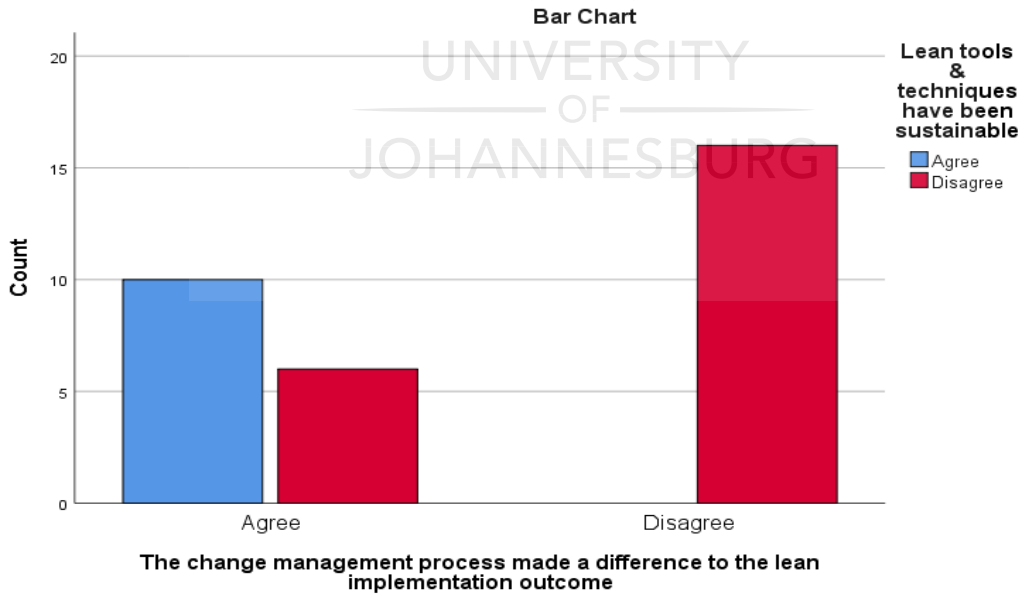

Figure 5.8: Sustainability in Relation to Change Management

When further analysis was conducted, evidence shows that adherence to planned activities also has a significant influence on the sustainability of the implementation, as can be seen in Figure 5.9. Respondents who had better adherence to planned activities had a higher degree of sustainability than those who had lower adherence to plan.

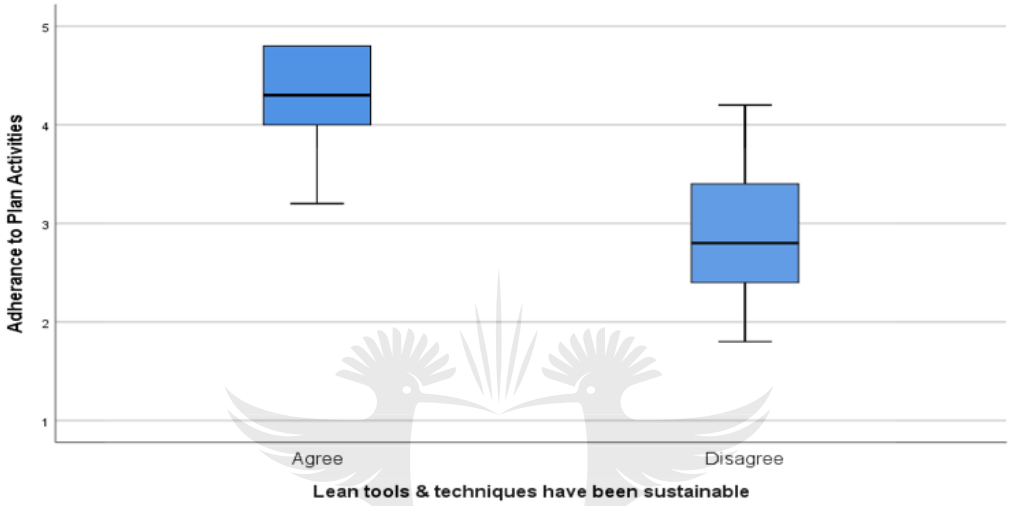

Figure 5.9: Sustainability in Relation to Adherence to Planned Activities

5.9 Conclusion

This chapter focused on the quantitative aspects of this study and from this perspective, many respondents in small and medium-manufacturing enterprises agree that their Lean implementations have been successful and that most of their aims were realised. There were no responses from micro-manufacturing enterprises leading to an inconclusive answer about the success of Lean in micro-manufacturing enterprises. Further research needs to be done to ascertain Lean success rate in micro-manufacturing enterprises. Chapter 6 focuses on the qualitative aspects of this study.

Chapter 6: Qualitative Results

6.1 Introduction

This chapter presents findings from personal interviews that were conducted with representatives of five different companies that implemented Lean. The company representatives were all project leaders in their respective companies. The interviews were structured around an interview schedule (refer to Appendix B).

The interview schedule used to collect the data consisted of seven sections:

1. Section A: Organisational Profile
2. Section B: Aims of Lean
3. Section C: Preparation Phase
4. Section D: Implementation Phase
5. Section E: Impact on Business Results
6. Section F: Sustaining Mechanisms
7. Section G: Learnings

6.2 Section A: Organisational Profile

The nature of Lean implementations is such that they are organisational culture interventions and in these types of interventions, organisational profiles play a key role in contextualising the environments in which they operate. When respondents were asked organisational profile-related questions (Table 6.1), their responses were:

Table 6.1: Organisational Profile

Organisational Profile	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	Role in Organisation?	HR Manager	Factory Manager	Production Manager	Operations Manager	Production Manager
	No. of employees before Lean?	80	89	47	35	69
	No. of employees after Lean?	120	126	52	42	72
	Employee growth?	40	37	5	7	3
	Length of Implementation (in years)?	7	2,5	4	1	3
	Name of the Lean Initiative?	Mission-Directed Work Teams	Workplace Transformation Toolkit	Mission-Directed Work Teams	Workplace Transformation Toolkit	Mission-Directed Work Teams

Similar to the quantitative study, the researcher was unable to access interviews with micro-manufacturing enterprises that had implemented Lean. The qualitative study, therefore, will focus on responses from small and medium-manufacturing enterprises. The number of small-manufacturing enterprises that were interviewed was one while the number of medium-

manufacturing enterprises was four. It is important to highlight that one of the four medium-manufacturing enterprises was a small enterprise prior to Lean implementation and that, as part of its Lean success, the company could grow and become a medium manufacturing enterprise.

Evident from the data set is that the length of implementation varied substantially from one company to the next, with the longest period being seven years and the least being one year. A detailed discussion on the link between the implementation period and sustainability follows in the next chapter. It is also evident from all the responses that their Lean approaches were all consultant-driven as opposed to internally-driven programmes. When respondents were asked further regarding the consultants' programmes, they indicated that they (respondents) would not have been able to deploy an internal programme due to their minimal experience with Lean deployments. The respondents found the consultants' experience and abilities instrumental in directing the programme and some respondents attributed part of their success to the consultants.

Another key aspect of the organisational profile has to do with the role of the project leaders in their organisation. Similar to the quantitative study, the project leader role is dominated by managers from operations. From the Table 6.1 data set, four of the five respondents were operational managers and only one was from support services. When the managers were probed about why they were selected to lead the project, all five respondents said they were the obvious choice because they initiated the Lean initiative in their respective companies. Another reason for being chosen was the effect of the positional power they have because operational managers have more employees than other departments and, therefore, tend to sway the direction of the entire company.

6.3 Research Question and Sub-question 1

When respondents were asked about their aims for implementing Lean, all five respondents said it was about improving productivity. At the heart of improving productivity was having a competitive edge that enabled the companies to stay ahead of the competition. Table 6.2 summarises responses relating to the aims of wanting to implement Lean.

Table 6.2: Lean Implementation Aims

Aims	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	What was the aim of implementing Lean?	To empower and upskill shop-floor workers from a family business to a corporate environment	To engage the workforce towards productivity improvement	To establish world-class manufacturing standards	To improve productivity and Good Manufacturing Practice (GMP)	To improve productivity
	Was there a formal business case prior to implementation?	It was not formalised but rather an ideal high-level objective	Not documented but high-level clarity on what the programme was for	Yes – driven by the HR Director	It was not formalised but rather an ideal high-level objective	No, only a high-level objective to improve productivity

When asked about a measure/metric that was used to determine the success of the Lean implementation, four of the five respondents said their measures were Quality, Speed/Delivery, Cost, Safety and Morale/People. The one remaining respondent said the measure had been a Quality KPI as measured through their customer audits and a people measure that looked at employee absenteeism. Table 6.3 summarises the responses as follows.

Table 6.3: Lean Implementation Success Metric

Impact on Business Results	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	How did you measure the impact of each lean technique as you implemented ?	Measured the impact of the Lean programme against Quality, Speed, Cost, Safety and People focus areas and these were measured monthly	Through the following KPIs: Absenteeism, Injury on Duty, Quality Faults and Sales Growth	Firstly, on understanding and articulation of Lean principles and secondly, it was measured on its impact on Quality, Speed, Cost, Safety and People focus areas	Customer quality audit outcomes and absenteeism	Measured the impact of the Lean programme against Quality, Speed, Cost, Safety and People focus areas and these were measured monthly
	How did the impact of each technique affect your business results?	Overall performance of Quality, Speed, Cost, Safety and People improved in the seven-year period of	3% improvement in absenteeism, injury on duty reduced by 4 incidents and quality faults per	Overall performance improved across identified Quality, Speed, Cost, Safety and People KPIs	Achieved green score for major customer (Woolworths) audit and 1% improvement in	Realised positive benefits on Quality and Speed KPIs

Impact on Business Results	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
		implementing the solution	unit improved by 4.86	through the strengthening of problem-solving using the 5 Why technique	absenteeism	
	Would you say the lean implementation was a success or failure?	During the seven-year period, the answer is yes, the implementation was a success, but it has not been sustainable since it stopped four years ago	Yes, it has been successful	Yes, it has been successful	Yes, it has been successful	Yes, during the 3-year implementation phase

When further asked about the success of the Lean initiatives in relation to the aims of the programme, all five respondents said their implementation had been a success. Figure 6.1 presents a graphical representation of responses when respondents were asked about the success of Lean in their respective organisations.

Figure 6.1: Lean Success Rate

6.4 Research Sub-question 2

This research question is aimed at understanding factors associated with a Lean implementation outcome. When respondents were asked questions relating to their level of preparedness, three focus areas stood out. The first focus area that stood out was change management; only two of the five companies had done extensive work in understanding the Lean implementation requirements to prepare the organisation for change. When further asked about senior leadership commitment and shop-floor buy-in, most respondents highlighted this as a problem, as they did not have much buy-in from senior management and the shop-floor.

The second focus area that stood out has to do with budget allocations. Three of the five respondents indicated that their budget was adequate while the other two respondents indicated that their budget was inadequate. The third focus area that stood out was the respondents' prior experience with Lean. Only two of the five respondents had prior exposure to Lean. Lack of exposure and experience with Lean would have meant the organisation solely dependent on the consultant to guide them through the implementation. Table 6.4 presents a summary of the responses during the preparation phase of the Lean implementation.

Table 6.4: Lean Implementation Preparation Phase

Preparation Phase	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	Was change management applied prior to implementation?	No	No	Yes	Elements of it through an initial staff meeting communication that detailed the Lean journey	No
	Was there an external change management resource supporting the organisation?	No	No	No	No	No
	Was there a Lean champion identified?	Yes	Yes	Yes	Yes	Yes
	Did the champion have prior experience with Lean implementation?	Yes	Yes	No	No	No

Preparation Phase	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	Was there an external Lean coach supporting the organisation?	Yes	Yes	Yes	Yes	Yes
	Were there other role-players supporting the initiative?	Managing Director	QC Manager and Executive Team	HR Manager and HR Director	Production Manager and Managing Director	Factory Manager and HR Manager
	Did you have a budget dedicated to the initiative?	Yes, but inadequate	Yes	Yes	Yes	Yes, but inadequate
	What guided the budgeting process and the actual budget?	It was guided by the consultants	It was guided by the consultants and Finance Budget	It was guided by the consultants and Finance Budget	It was guided by the consultants and Finance Budget	It was guided by the consultants and Finance Budget
	What constituted the budget?	Consulting costs, training material costs, costs associated with 5S,	Consulting costs, training material costs, costs associated with 5S,	Consulting costs, training material costs, costs associated with 5S,	Consulting costs, training material costs, costs associated with 5S,	Consulting costs, training material costs, costs associated with 5S,

Preparation Phase	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
		costs associated with visual management charts and costs associated with improvement ideas	costs associated with visual management charts and costs associated with improvement ideas	costs associated with visual management charts and costs associated with improvement ideas	costs associated with visual management charts and costs associated with improvement ideas	costs associated with visual management charts and costs associated with improvement ideas
	Did you have an overall implementation plan	Somewhat – It was a high-level consultant's plan	Somewhat – It was a high-level consultant's plan	Somewhat – It was a high-level consultant's plan	Somewhat – It was a high-level consultant's plan	Somewhat – It was a high-level consultant's plan

When respondents were asked about the Lean principles on which they were trained and approach to implementation, it is clear that the companies that had implemented Lean the longest were the ones with more principles implemented in the organisation. Table 6.5 summarises responses of the interviewees.

Table 6.5: Lean Implementation Phase

Implementation Phase	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	What was the approach towards implementation?	Train-the-trainer approach across the entire site	Consultants trained everybody onsite	Consultants trained everybody onsite	Consultants trained everybody onsite	Train-the-trainer approach across the entire site
	What lean principles & techniques were you (as an organisation) trained on?	Goal Alignment (visual management), 5S, value stream mapping, self-development, waste elimination and problem-solving	Goal Alignment, teamwork, leadership, cleaning and organising	Goal Alignment (visual management), 5S, Kanban, OEE and waste elimination	5S and Teamwork	Goal Alignment (visual management) and 5S
	Which lean principles and techniques did you (as an organisation) implement?	Visual management, 5S, value stream mapping, self-development, waste	Goal Alignment, teamwork, leadership, cleaning and	Goal Alignment (visual management), 5S, Kanban, OEE and	5S and Teamwork	Goal Alignment (visual management) and 5S

Implementation Phase	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
		elimination and problem-solving	organising	waste elimination		

6.5 Research Sub-question 3

This research question is aimed at understanding the sustainability of Lean implementations. When respondents were asked about the sustainability of the results they achieved, three of the five respondents said the results had been sustained while the other two said results had not been sustained. Table 6.5 summarises responses relating to the sustainability of the implementation.

Table 6.5: Lean Implementation Sustainability

Impact on Business Results	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	How sustainable were those results?	People, Quality KPIs have not been sustained in the last four years	Results have been sustained with further improvements on absenteeism and faults per unit being realised	Overall results have been sustained and the principles embedded in the organisation's culture	Results have thus far sustainable	Performance regressed second year after stopping the implementation

When respondents were further asked about sustaining mechanisms that they had in place, all of the respondents had some form of governance structure in place to manage the system. When asked about adherence to routines and execution of actions relating to the implementation, those that did not sustain the implementation said adherence to routines had been part of the reason for not sustaining the initial gains. The two respondents found that, as the consultant spent less time with them as their system matured, the more the old habits of allowing business priorities to take from building systems came back and started distracting their focus.

When respondents were asked about the role of money in implementing and sustaining Lean, only one out of the five respondents said they paid their workers to implement the system and to reward good results. The one respondent that had paid employees found that paying for the implementation had been a wrong decision that should not have been implemented with Lean because as soon as they were unable (for financial constraints reason) to pay the employees, the employees stopped using the system; hence, the inability to sustain the initial gains they achieved. Table 6.6 summarises responses relating to sustaining mechanisms.

Table 6.6: Lean Implementation Sustaining Mechanisms

Sustaining Mechanisms	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	Did you have governance structures to support the initiative?	Quarterly plant level committee meetings and six-monthly milestone workshops	Steering committee	Steering committee and quarterly union/management forum	Quarterly plant level committee meetings and six-monthly milestone workshops	Steering committee
	Did you pay employees to participate in the initiative?	No	No	No	No	Yes
	Did you have a reward or recognition system to support the initiative?	Yes – not monetary	Yes – monthly and not monetary	Yes, but never monetary	Yes, recognition system but not monetary	Yes, it was centred around incentive bonuses. Had a monetary element

Sustaining Mechanisms	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	What was the role of the external resources/consultants after initial implementation?	Coaching Reviews	Coach and audit the system	Coaching Reviews	Coach and audit the system	Coaching Reviews

When respondents were asked about their learnings, having gone through their respective implementations, the following themes stood out:

- Senior leadership commitment
- Shop floor buy-in
- Internal Lean skills/expertise
- A good change management plan that is guided by research
- The pace of implementation should be designed to suit the organisation

A summary of key learnings as per responses is presented in Table 6.7.

Table 6.7: Lean Implementation Key Learnings

Learnings	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
	What factors would you say contributed to the Lean outcome that you had?	Guidance from the consultant, recognition system, Managing Director's commitment towards the system	Leadership commitment and executives walking the talk by personally conducting audits	Senior leadership commitment and shop-floor buy-in	Shop-floor buy-in and Consultant support	Factory Manager commitment, adherence to steering committee routines and consultant's guidance
	In hindsight, how would you have approached the implementation knowing what you know now?	Break down the principles in very small chunks to allow in-depth understanding of the principles and to ensure everyone is able to follow the implementation	Ensure senior leadership is involved, crystalize the vision and objectives in everyone's mind and mobilise everyone towards achieving common goals	More emphasis that it's not about the tools it's about the knowledge that we get from the tools. So, the tools is what goes into your head and what stays in your head	Implemented the principles slightly slower than we approached it	Ensured there was a strong change management focus for senior leadership. Not all members of the senior leadership team bought into the process and that affected the implementation and derailed it completely when the

Learnings	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
						Factory Manager resigned
	What would be your advice for any company embarking on this journey?	A lot of research to understand what you are trying to do and to ensure there's leadership understanding and commitment prior implementation. Our implementation lacked support from key Directors; hence, the lack of sustainability	Ensure shop-floor and senior management relationship is healthy and strong and don't forget to recognise efforts	There's no one way of doing business, always challenge yourself to do better	Don't treat it as a hundred-yard dash, it's a marathon. Take it step-by-step, start with the smaller projects first just to get yourself into that mode, and tackle the bigger projects when you have the means to do so. Always go for what you can afford to do first, don't try to bite too much off at once	Ensure there's considerable buy-in from shop-floor to senior management (especially the influential individuals) and also, properly understand the journey before you start

Learnings	Questions	Interviewee #1	Interviewee #2	Interviewee #3	Interviewee #4	Interviewee #5
					because then you get overwhelmed and you give up.	

6.6 Conclusion

This chapter focused on the qualitative aspects of this study and from this perspective, all the respondents in small and medium-manufacturing enterprises agree that their Lean implementations have been successful and that their aims were realised. There were no responses from micro-manufacturing enterprises leading to an inconclusive answer about the success of Lean in micro-manufacturing enterprises. Further research needs to be done to ascertain Lean success rate in micro-manufacturing enterprises. Chapter 7 focuses on the qualitative aspects of this study.

Chapter 7: Discussion of Results

7.1 Introduction

This chapter analyses data presented in Chapters 5 and 6 in conjunction with the literature review presented in Chapter 2. The analysis is presented in the form of research questions that are stated in Chapter 3.

7.2 Research Question and Sub-question 1

This research question looks at the success rate of Lean manufacturing among South African based SMMMEs while the research sub-question 1 delves into the metrics used to establish Lean success. The respondents were asked if the performance focus areas of Safety, Quality, Delivery/Speed, Cost and Morale accurately measured productivity. In both quantitative and qualitative studies, all of the respondents agreed that the performance focus areas of Quality, Speed/Delivery, Cost, Safety and Morale/People were good measures for Lean. This agreement is consistent with Womack et al. (1990) and Kobayashi's (1990) findings where Lean results were presented using the same five focus areas.

When respondents were further asked about the success rate regarding the five performance focus areas, 100% of the respondents in the qualitative study and 62.5% from the quantitative study agreed that their implementations had been a success. Rothenberg and Cost's (2004) findings also supported the results that there are immense benefits for most small enterprises in adopting Lean principles.

7.3 Research Sub-question 2

This research question is aimed at understanding the factors associated with a Lean implementation outcome. Data from both the qualitative and quantitative studies point out the following themes:

- Senior leadership commitment
- Shop floor buy-in
- Adequate budget
- Internal Lean skills/expertise
- Change management linked with company culture change understanding

The aforementioned enablers came out strong in the qualitative study and need to ensure that the gaps are addressed was regarded as a crucial step to ensuring the implementation was successful. The above findings are also consistent with previous findings from Emiliani (2017), Pingyu and Yu (2010) and Rothenberg and Cost (2004). Their findings included the following enablers:

- Employee resistance to Lean
- Customisation of principles such that they address the organisation's specific needs
- Senior leadership resistance
- Lean expertise within the SMMEs

The question of which Lean programme was better and more likely to succeed was not, according to the outcomes of this study, a factor to consider. Further research needs to be done to ascertain the impact of Lean programmes on the implementation outcome.

7.4 Research Sub-question 3

This research question is aimed at understanding the sustainability of Lean implementations. When respondents were asked about the sustainability of the results they achieved, 60% of the respondents in the qualitative study agreed that their implementation had been sustainable compared to 31% that agreed in the quantitative study.

When interviewees were probed further regarding factors influencing sustainability, the following themes were raised:

- Adherence to routines set-up during the initial implementation phase
- Senior leadership support
- The pace of implementation
- Internal Lean skills/expertise
- Adequate budget

The above findings are consistent with Leite's (2016) findings summarised in Chapter 2 of this study. Leite classified the barriers and enablers into two aspects, namely cultural and technical aspects. The cultural aspects were found to have a major impact on the success and sustainability of Lean deployments, constituting 64% of the barriers while the technical aspects

constituted 36%. Leite superimposed the cultural and technical aspects on Hines' Lean iceberg model to illustrate the difficulty of seeing and addressing the cultural aspects of a Lean deployment, arguing that the technical aspects were easier to address than the cultural aspects. Although Leite's findings were not specific to SMMEs, those barriers and enablers lined up with outcomes of this study.

7.5 Hypotheses Testing

Because of the small sample size that was analysed in the quantitative study, the data was tested using parametric statistics.

7.5.1 Testing of hypotheses 1

H_1 aims to understand if the success rate of Lean implementations will likely fall below 40%. The scores of the sub-questions in the questionnaire pertaining to hypotheses 1 were added together for each respondent, after which the average score was calculated for each question. The individual scores were then compared against each other and thereafter tested for normality. The outcome of the tests are outlined in Table 1.

Table 8.1: Normality Tests – Chi-Square Tests

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.743[a]	1	0,098		
Continuity Correction[b]	1,659	1	0,198		
Likelihood Ratio	2,839	1	0,092		
Fisher's Exact Test				0,147	0,098

Linear-by-Linear Association	2,657	1	0,103		
N of Valid Cases	32				

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 5,25.

b. Computed only for a 2x2 table

Based on the values of the Pearson and Fisher's Exact tests, the sample size does not affect the reliability of the results and as such, confirm that H_{01} is true in that the success rate for SMMME lean implementations in Gauteng Province of South Africa are greater than 40% and that Lean implementations are more likely to be successful than not.

7.5.2 Testing of hypotheses 2

H_2 aims to understand if the following factors of management experience, Lean expertise, company culture, business needs, employee training, availability of financial and human resources will result in a failed implementation. Similar to hypotheses 1 testing, the scores of the sub-questions in the questionnaire pertaining to hypotheses 1 were added together for each respondent, after which the average score was calculated for each question. The individual scores were then compared against each other and thereafter tested for normality. The outcome of the tests are outlined in Table 2.

Table 3 outlines the results and interpretations of the hypotheses testing, as well as the statistical measures that were used.

Table 9.2: Normality Tests – Shapiro-Wilk Test

Tests of Normality

Shapiro-Wilk

D3.6		Statistic	df	Sig.
ChangeMan	Agree	0,927	20	0,136
	Disagree	0,903	12	0,174

IntSkillsCap	Agree	0,864	20	0,009
	Disagree	0,753	12	0,003
AdhPlanAct	Agree	0,911	20	0,067
	Disagree	0,924	12	0,318

Based on the values of the Shapiro-Wilk test, the p value is greater than the chosen alpha level thus confirming that the data is from a normally distributed population and cannot be rejected and as such, confirm that H_{02} is true in that the following factors of management experience, Lean expertise, company culture, business needs, employee training, availability of financial and human resources will result in a failed implementation.

Table 10.3: Results of statistical hypothesis testing

Null hypo-theses	Statistical Measures Used	Result	Interpretation
H_1	• Chi-Square Test • Fisher's Exact Test	Rejected	Evidence points out that the likely hood of a successful Lean implementation in small and medium-manufacturing enterprises is greater than 40% thus H_1 is rejected
H_{01}	• Chi-Square Test • Fisher's Exact Test	Accepted	Evidence agrees that the likely hood of a successful Lean implementation in small and medium-manufacturing enterprises is greater than 40% thus H_{01} is accepted
H_2	• Shapiro-Wilk Test	Accepted	Evidence agrees that the following factors of management experience, Lean expertise, company culture, business needs, employee training, availability of financial and human

			resources will result in a failed implementation thus H_2 is accepted
H_{02}	• Shapiro-Wilk Test	Rejected	Evidence agrees that the following factors of management experience, Lean expertise, company culture, business needs, employee training, availability of financial and human resources will result in a failed implementation thus H_{02} is rejected

7.6 Conclusion

This chapter focused on discussing the outcomes from the quantitative and qualitative studies in relation to the literature review. Only responses from small and medium-manufacturing enterprises were discussed because there were no responses from micro-manufacturing enterprises leading to an inconclusive answer about the success and sustainability of Lean in micro-manufacturing enterprises. Further research needs to be done to ascertain Lean success rate in micro-manufacturing enterprises. Chapter 8 presents the conclusions and recommendations.

Chapter 8: Conclusion

8.1 Introduction

This chapter consolidates the findings from analysed data presented in Chapters 5, 6 and 7, offering recommendations for small and medium-manufacturing enterprises and suggesting future research questions. Micro-manufacturing enterprises were not analysed due to the unavailability of sample sites and thus, a recommendation is made to look into these enterprises as part of future research work.

The research could address the main question and three sub-questions posed in Chapter 3, based on the literature review in Chapter 2 and from the analysis done on all the responses from the qualitative and quantitative studies. The research intended to understand the success rate of Lean implementations in South African based SMMMEs, factors that influence the implementation outcome, and sustainability of the successes that were achieved. Six key success factors were derived in Chapter 7, and this chapter looks at those six factors in more detail and providing recommendations to SMMMEs for analysis on how to effectively manage these factors.

8.2 Success Rate

The study established that there are advantages to implementing Lean in small and medium-manufacturing enterprises. Majority of companies sampled in this study agreed that their Lean implementations had been successful and evidence supports Hypotheses H_{01} in that implementation success is greater than 40%. The question of sustainability was treated separately to implementation success because implementation looks at putting in place initially while sustainability looks at maintaining a system that has been put in place.

Although the majority of the companies were successful with their initial implementations, the opposite was true for Lean sustainability. Most companies found the implementations not sustainable and the factors that influenced this outcome are similar in nature to the factors affecting the success of an implementation. These factors are discussed in detail in the rest of this chapter.

8.3 Factors that Influence a Lean Implementation Outcome

A Lean outcome refers to the success of deployment and its sustainability. Factors that influenced the success and sustainability of the project were found to be linked and, therefore, were combined. There is enough evidence to support Hypotheses H_2 in that the following factors of management experience, Lean expertise, company culture, business needs, employee training, availability of financial and human resources will result in a failed implementation.

8.3.1 Senior leadership commitment

Senior leadership commitment can be defined as the direct participation by the highest-level management in all specific and critically important aspects of the Lean programme (Emiliani, 2017). This commitment goes beyond words into actions and at times, into leading by doing. The analysis conducted in this study captured senior leadership commitment as a key enabler or barrier to the deployment of Lean for the following reasons that are also consistent with Christodoulou's (2008) findings:

- Senior leadership ensures the necessary resources are acquired and deployed
- Actively and effectively address any obstacles that get in the way
- Create an active dialogue about the desired state with all stakeholders
- Communicating in public and in one-on-ones with key individuals
- Rewarding and punishing individuals and constituencies for consistent or inconsistent behaviour

Companies that were found to have been successful and sustainable in the qualitative study are those where senior leadership commitments was visible. Respondents that had prior experience with Lean found that even with their prior experience, the lack of senior leadership commitment made their job extremely hard and at times to the detriment of the programme.

Recommendations

Because of the highly competitive business environment of small and medium-manufacturing enterprises, senior management tends to look at business initiatives with an outcome-based 12-month window. This requires the Lean project team to conduct an extensive business case that

will resonate with senior management and within the time frames expected by the same management prior to implementation. Taking senior management on a plant visit to other Lean sites can also prove beneficial in painting a bigger picture to the senior management team.

Once the business case and site visits are conducted, the responsibilities and requirements of senior leadership need to be communicated and agreed upon to create ownership. Then, participation in steering committees or joint operational forums needs to have senior management representation. This will encourage collaboration across different levels of the organisation. It would also be beneficial for senior management to attend periodic Lean conferences where they will be exposed to Lean practitioners and other companies implementing Lean.

8.3.2 Adequate budget

An adequate budget has been identified as a key enabler of a Lean deployment. Adequate budget refers to financial resources that adequately cover costs associated with Lean deployment. These costs include:

- Visual management charts
- Implementation of improvement ideas
- Costs associated with implementing 5S
- Consulting costs
- Training material costs

Results of the quantitative analysis established that a budget is required to support a Lean deployment. The adequacy of this budget, however, was not fully correlated but the qualitative analysis could expand the adequacy question to the point of establishing a correlation between a Lean outcome and an adequate budget. There was a strong link established in the qualitative study between an adequate budget and a Lean outcome.

The first challenge with establishing an adequate budget relates to funding consulting support. Because SMMMEs rely on consulting services to drive their Lean programmes, an acceptable amount of money is required to fund this need. Establishing an appropriate amount required to fund the deployment tends to be difficult to establish prior to implementation due to varying challenges experienced by companies.

The second challenge relates to a company's ability to establish guidelines for improvement ideas and the ability to use those guidelines to establish a practical budget to fund those ideas. Estimating the number and cost of the improvement is virtually impossible prior to implementation but defining an improvement project and guidelines helps to establish what a reasonable budget will be.

The third challenge relates to a company's ability to cost requirements for a 5S deployment. This issue is easier to establish, as costs associated with 5S tend to fall in the following categories:

- Painting requirements
- Cleaning/housekeeping requirements
- Demarcation requirements (including cupboards)
- Standardisation requirements

Training and visual management costs tend to be easy to establish prior to implementation and were not found to be a factor in establishing an adequate budget.

Recommendations

To support better budgeting, the following challenges will need to be addressed:

1. Appropriate consulting needs analysis – it is recommended that a readiness assessment should be conducted at the company prior to implementation to inform the approach to be taken. Clarity of the approach will inform consulting time and, thereby, costs associated with consulting support.
2. Management of costs associated with improvement ideas – establish clear guidelines that define what should be considered as an improvement idea and the amount to be allowed for an average improvement idea. The guidelines and a target relating to the number of improvement ideas expected per team will help establish budgetary requirements for improvement ideas.
3. Management of costs associated with 5S – understanding 5S categories is key in establishing budgetary requirements. There

are four basic categories that are highlighted above, and these can be used as a guide to establish the budgetary requirements.

8.3.3 Internal lean skills/expertise

Internal Lean skills/expertise has been identified as the third enabler to a Lean deployment. Internal Lean skills/expertise refers to prior Lean exposure and deployment capabilities of individuals in the project team. Christodoulou's (2008) finding that Lean skills and expertise do impact a Lean outcome, supports the findings of this study.

The results of the quantitative analysis established a strong correlation between a Lean outcome and internal Lean skills/expertise. The qualitative analysis further confirmed this finding with further elaboration. It is evident from the qualitative analysis that prior exposure to Lean assisted project leaders to properly develop a deployment approach that was conducive to the environment.

The second finding was the degree at which all the companies needed consulting support to deploy a programme. It is evident that internal Lean skills/expertise are not at a level that would result in an internally developed programme. Consultants' approach appears to dominate the South African Lean space.

Pingyu and Yu (2010) further support the above findings in that only 40% of SME managers have heard of Lean. Research and application of Lean manufacturing are primarily found in universities, academy of sciences and mainly large enterprises.

Recommendations

The global Lean community has grown substantially over the years and free material (including web seminars or webinars) are largely available. It is recommended that companies spend enough time prior to engaging consultants on understanding Lean and its implications to have a good sense of what the principles are about.

Secondly, it is recommended that a company goes through at least one site visit prior to implementation to other SMMMEs applying their preferred consultant's programme to understand and visualise the roadmap.

8.3.4 Shop-floor Buy-in

The fourth enabler that was identified is shop-floor buy-in. Shop-floor buy-in refers to the level of commitment and support by all affected employees towards the change initiative. This finding is consistent with Pingyu and Yu's (2010) finding. Pingyu and Yu consider the following two aspects as the causes of lack of buy-in:

1. Natural habits that are informed by personal insecurity, bad personal habits and natural hesitation
2. The new system will negatively affect other company systems that do work

Results of the qualitative analysis could create a link between shop-floor buy-in and the results achieved by respondents. Two out of the three successful respondents said their success and sustainability of results were attributed partly to shop-floor buy-in. It is evident from the study that shop-floor buy-in does significantly contribute to the outcome of Lean in the context of the other five enablers identified in this study.

Recommendations

It is critical to the success and sustainability of Lean to obtain shop-floor buy-in. It is recommended that as part of the change management plan, aspects that relate to employee or job security are properly factored. It is important to address concerns that normally arise about the possibility of job losses because of productivity improvement. Lean implementations should not be linked with job losses.

Furthermore, it is recommended that union or employee representatives form part of the steering committee and drive implementation efforts. When union or employee representatives are part of the decisions that relate to Lean, the more likely they will sell the concepts properly compared to a situation where they are not involved.

Lastly, communication sessions by the most senior member of the organisation to all employees are recommended. This will provide an opportunity for all employees to ask questions relating to matters that might concern about Lean.

8.3.5 Change management

Change management was identified as the fifth enabler. Change management refers to efforts that go to preparing and supporting employees and companies in making a successful organisational change. It drives cultural readiness for the change required. After more than 14 years of research with corporate change, Hiatt (2006) developed a practical approach to change management that is structured around the ADKAR model, which consists of the following categories:

1. Awareness – looks at the degree to which others are aware of the need for change
2. Desire – looks at the willingness to want to make the change a success
3. Knowledge – the learning process that informs how one needs to change
4. Ability – turning knowledge into action by implementing the required skills and behaviours
5. Reinforcement – sustaining the change and celebrating success

Results from both the quantitative and qualitative studies highlighted a strong correlation between change management and the outcomes of the implementation. Respondents that had change management initiatives were found to have been successful in their implementations and that they had a better chance of having a sustainable implementation when compared with companies that did not have change management initiatives. One of the key change management activities that were common among most respondents relates to effective communication on the need for change; most respondents had this item executed in one form or another.

Recommendations

It is recommended that as a first step, establish a steering committee that includes union or employee representatives and members of senior management. The steering committee will be the governance structure that will direct all implementation efforts. It is recommended that the meeting frequency be at least monthly to ensure enough time is allowed to close actions and give feedback.

Furthermore, it is also recommended that a burning platform that resonates with all levels of the organisation is established. A burning platform is critical in developing a case for change that will be the bases for awareness communication. The communication mechanism needs to ensure that every member of the organisation will be addressed. Communication workshops with all employees by a senior member of the organisation are critical in setting the tone prior to deployment.

The third recommendation addresses a need for employee and management concerns to be understood and documented in a project risk analysis matrix that will inform decision making. Risk analysis is crucial in helping the project team to manage resistance to change.

8.3.6 **Pace of implementation**

The pace of implementation was identified as the sixth and final enabler. The pace of implementation refers to the speed at which an organisation implements an initiative to ultimately ensure the principles are well entrenched across the entire organisation.

According to Pingyu and Yu (2010), many SMEs implement Lean principles without fully understanding the true meaning of it. The need and want to realise Lean benefits often guide the pace at which organisations implement Lean even if it is at the organisation's detriment. Results from the qualitative analysis highlight that three out of five respondents agreed that the pace at which an organisation implements Lean does influence the implementation outcome.

Recommendations

Organisations can adopt an audit process or maturity assessment mechanism that measures the degree at which Lean principles are entrenched in the organisation. Organisations need to define the level which they need to reach before proceeding with implementation. This process can be a combined effort with a consultant or done in-house without consultants.

8.4 Future Research Ideas

Future research can be conducted to determine the validity of the findings in this research by replicating the same approach across a larger sample of SMMMEs in all provinces of South Africa. Further research can also be conducted to establish the success rate of Lean implementations, specifically among micro-manufacturing enterprises by replicating the same approach. Further research can be conducted to establish the impact of Lean programmes on

the implementation outcome. The type of Lean programme organisations implement might have an influence on the success rate among SMMMEs. Lastly, further research can be conducted to determine the validity of factors that ensure Lean remains sustainable after implementation is proven to be successful.

8.5 Conclusion

In conclusion, this research has highlighted the success rate of Lean implementations in small and medium-manufacturing enterprises in South Africa. Furthermore, the research has elaborated on factors or enablers that influence Lean outcomes among small and medium-manufacturing enterprises in South Africa. Lastly, this research has highlighted the rate of sustainability for Lean implementations in small and medium-manufacturing enterprises.

Beyond the outcomes highlighted above, this research will contribute to the knowledge base of Lean manufacturing from an implementation perspective by integrating it with project management principles; reinforcing the literature and findings from the analysis as well as highlighting issues that are unique to South African SMMMEs. It is hoped that this research will add value to the Lean manufacturing knowledge base of small and medium-manufacturing enterprises.

LIST OF REFERENCES

Aguirre, D., Von Post, R., & Alpern, M. (2013). *Culture's. role in enabling organizational change*. Booz & Company. https://www.strategyand.pwc.com/media/file/Strategyand_Cultures-Role-in-Enabling-Organizational-Change.pdf

Ambler, W. (2001). *The education of Cyrus.* Cornell University Press

Amra, R., Hlatshwayo, A., & McMillan, L. (2013). SMME employment in South Africa. *Paper to be presented at the biennial conference of the Economic Society of South Africa, Bloemfontein, 25-27th September 2013*: 2-6.

Ayres, R. U., & Miller, S. M. (1983). *Robotics: Applications and social implications*. Ballinger Press.

Baker Baynes. (2017). The history and future of manufacturing in South Africa https://bakerbaynes.com/history-future-manufacturing-south-africa/

Basu, R., & Wright, J. N. (2003). *Quality beyond six sigma*. Elsevier.

Berry, A. V., Von Blottnitz, M., Cassim, R., Kesper, A., Rajaratnam, B., & Van Deventer, D. E. (2002). *The economics of SMMEs in South Africa*. Trade and Industrial Policy Strategies (TIPS).

Altenburg, T., & Eckhardt, U. (2006). *Productivity enhancement and equitable development: challenges for SME development*. Vienna: United Nations Industrial Development Organization.

Roser, C. (2016). *Faster, better, cheaper in the history of manufacturing: from the stone age to Lean manufacturing and beyond.* Productivity Press

Christodoulou, A. (2008). *Factors of success for the effective implementation of lean manufacturing projects within the banking sector in South Africa*. University of Pretoria

Coetzee, R., van der Merwe, K. & van Dyk, L. (2016). Lean implementation strategies: How are the Toyota way principles addressed? *The South African Journal of Industrial Engineering*, 27(3).

Silvermintz, D. (2010). *Plato's supposed defense of the division of labor: A re-examination of the role of job specialization in the republic.* Duke university press

Dababneh, R., & Tukan, F. (2007). *Booklet for standardized small and medium enterprises definition*, 4 – 9. USAID.

De Vos, A. S. (2002a). Combined quantitative and qualitative approach. In De Vos, A. S. (Ed.), Strydom, H., Fouché, C. B., & Delport, C. S. L. In *Research at grass roots for the social sciences and human service professions* (2nd edition). Pretoria: Van Schaik Publishers.

Doray, B. (1988). *From Taylorism to Fordism: A rational madness*. Free Association Books.

Duhamel du Monceau, H. L. (1761). *The art of the pin-maker*. (11th edition, Vol. 8). Cambridge University Press.

Emiliani, M. L. (2017). *A study of executive resistance to Lean*. Unpublished work, 21 October, http://www.bobemiliani.com/goodies/exec_resist.pdf

Fuchs, M., Lacovone, L., Jaeggri, T., Pearson, R., Pellegrini, G., & Sanchez, C.V. (2011). *Financing small and medium enterprises in the Republic of South Africa*. The world bank, 12 – 20.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory – strategies for qualitative research*. Piscataway: New Jersey.

Graunt, J. (1899). *The economic writings of Sir William Petty (Vol. 1)*. (C. H. Hull, Ed.) Cambridge university press.

Greene, J. C, Valerie, J. C., & Graham W. F. (1989). *Toward a conceptual framework for mixed-method evaluation designs.* Educational Evaluation and Policy Analysis, 11(3):255-274.

Hennessey, M. (2017). *3 best practices to achieve lean in workcell design*. Otto Motors. https://ottomotors.com/blog/workcell-design-lean-manufacturing

Hiatt, J. (2006). *ADKAR: A model for change in business, government and our community*. Prosci Learning Center Publications.

Hirano, H. (1995). *5 pillars of the visual workplace: The sourcebook for 5S implementation*. Productivity Press.

Hoffman, A. (2011). *Taylorism and Fordism*. http://angelahoffman.weebly.com/uploads/9/8/2/4/9824766/taylorism_and_fordism.pdf

Hu, Q., Mason, R., Williams, S., & Found, P. (2015). Lean implementation within SMEs – A literature review. Manufacturing Technology Management, 26(7):30-58.

International Labour Organization. (2013). *Resolution concerning statistics of work, employment and labour underutilization*. Adopted by the 19th International Conference of Labour Statisticians: Geneva. http://www.ilo.org/global/statistics-and-databases/standards-and-guidelines/resolutions-adopted-by-international-conferences-of- labour-statisticians/WCMS_230304/lang--en/index.htm.

Kobayashi, I. (1990). *20 Keys to workplace improvement*. Productivity Press.

Krafcik, J. F. (1988). Triumph of the lean production system: Sloan management review. *Massachusetts Institute of Technology*, 30:4-5.

Le Fleur, H., Koor, J., Chetty, V., Ntshangase, S., Mackenzie, R., & Rawoot, F. (2014). Informal and SMME retailers in South Africa. *Wholesale & Retail SETA paper*, 5-9.

Leite, H., Bateman, N., & Radnor, Z. (2016). *Lean implementation and sustainability: A classification model of the main organizational barriers and enablers*. https://www.pomsmeetings.org/ConfProceedings/065/Full%20Papers/Final%20Full%20Papers/065-0660.pdf

Lekhanya, L. M. (2015). Public outlook on small and medium enterprises as a strategic tool for economic growth and job creation in South Africa. *Journal of Governance and Regulation*, 4(4)412-418.

Liker, J. K (2004). *The Toyota Way – 14 Management principles from the world's greatest manufacturer*. McGraw-Hill.

Markus, J. (2017). *Manufacturing*. Orbelo. https://www.oberlo.co.za/ecommerce-wiki/manufacturing

Mavlutova, I., Lesinskis, K., & Olevskis, G. (2017). *Contemporary role of SMEs in employment in manufacturing and service industries*. VGTU Press

Kreuser, C. F., & Newman, C. (2018). *Total factor productivity in South African manufacturing firms*. South African journal of economics

McKim, C.A. (2017). The value of mixed methods research: A mixed methods study. *Journal of Mixed Methods Research*, 11(2): 202-222. http://didier-jourdan.com/wp-content/uploads/2017/04/MM-and-Graduates-students.pdf

Ministry of Law and Justice. (2006). *The micro, small and medium enterprises development act of 2006.* New Delhi Legislative Department.

Moorthi, V. (2008). *The introduction of Lean Manufacturing in a selected South African organization*. Submitted in partial fulfilment of the requirements for the Degree of Masters in Business Administration, Durban Institute of Technology, 2008.

Muhammad, M. Z., Char, A. K., Bin Yasoa, M. R., & Hassan, Z. (2010). Small & medium enterprises competing in the global business environment: A case of Malaysia. CCSE International Business Research, 3(1):66-71.

Ohno, T. (1988). *Toyota production system – Beyond large scale production*. Productivity Press.

United Nations Conference on Trade and Development. (2016). *Trade and development report.* Geneva: United Nations

Pallant, J. (2007). *SPSS survival manual - A step by step guide to data analysis using SPSS for windows*. (3rd edition). Maidenhead: Open University Press.

Glotz, Gustave. (1926). *Ancient Greece at Work.* New York: Alfred A. Knopf.

Kuznets, S. (1966). *Modern economic growth: rate, structure, and spread.* Yale university press.

Langdon, D., & Lehrman, R. (2012). *The benefits of manufacturing jobs.* U.S. Department of Commerce: Economics and statistics administration brief#01-12.

Pingyu, Y., & Yu, Y. (2010). The barriers to SME's implementation of Lean Production and Countermeasures – based on SMEs in Wenzhou. *International Journal of Innovation, Management & Technology*, 1(2):4-6.

Pitout, C. J. (2006). *Determining the critical success factors for implementing Lean Manufacturing in South Africa: A case study*. Nelson. Mandela Metropolitan University.

Plumb, J. H. (1965). *England in the eighteenth century*. Penguin Books.

Rodseth, P. (2016). *The importance of manufacturing for SAs economic growth*. EE Publishers. http://www.ee.co.za/article/the-importance-of-manufacturing-for-sas-economic-growth.html

Rothenberg, S., & Cost, F. (2004). *Lean manufacturing in small and medium sized printers*. Rochester Institute of Technology. Printing Industry Center, 1:7-10.

Schonberger, R. J. (1982). *Japanese manufacturing techniques: Nine hidden lessons in simplicity*. Macmillan, New York

Schoonenboom, J., & Johnson, R. B. (2017). *How to construct a mixed methods research design*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5602001/

Sharma, S., & Chikhalikar, P. (2015). *Implementation of Lean manufacturing in an engine manufacturing unit*. http://www.ijmerr.com/v4n1/ijmerr_v4n1_46.pdf

Shingo, S. (1981). *A study of the Toyota Production System*. Productivity Press.

Shingo, S. (1986). *Zero quality control: Source inspection and the poka-yoke system*. Productivity Press.

Shingo, S. (1988). *Non-stock production: The Shingo system for continuous improvement*. Productivity Press.

Womack, J., & Jones, D. (1993). *Lean Thinking: Banish waste and create wealth in your corporation.* Free press.

Smalley, A. (2002). *Toyota production system basic handbook.* http://www.artoflean.com/files/Basic_TPS_Handbook_v1.pdf

Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations*. MetaLibri.

Taylor, F. W. (1910). *The principles of scientific management*. Harper & brothers.

The Small Enterprise Development Agency. (2018). *SMME Quarterly Update – 1st Quarter 2018*. http://www.seda.org.za/Publications/Publications/SMME%20Quarterly%202018-Q1.pdf

Trading Economics. (2018). *GDP growth*. https://tradingeconomics.com/south-africa/gdp-growth

Roosevelt Institute. (2011). *Six reasons manufacturing is central to the economy.* http://rooseveltinstitute.org/six-reasons-manufacturing-central-economy/

University of Kentucky. (2018). *Lean systems program: True Lean*. https://w2.engr.uky.edu/lean/reference/terminology/

Vyas, K. C. (2011). *Toyota production system*. The University of Texas at Austin.

Ward, M., & Rhodes, C. (2014). *Small businesses and the UK economy*. House of Commons Library, 1 – 5.

Ward, S. (2018). *SOHOs are the most numerous types of business*. The balance small business: https://www.thebalancesmb.com/small-office-home-office-soho-2948189

White, L. (2005). *Small business: The case of Brazil*. The South African Institute of International Affairs, 9-13.

Haraguchi, N. (2015). *Patterns of structural change and manufacturing development.* New York Routledge.

Womack, J. P., Jones, D. T., Roos, D., & Carpenter, D. (1990). *The machine that changed the world*. Collier Macmillan Canada.

Wood, A. (1963). *Nineteenth century Britain*. London: Logmans

Gunasekaran, A., & Lyu, J. (1997). *Implementation of just-in-time in a small company.* Production Planning & Control – The Management of Operations, 8(4):406-412.

Productivity SA. (2016). *Workplace challenge annual report*. https://www.cmsignition.co.za/download/files_1268/PSAWorkplaceChallengeAnnualReport2016FINAL1.pdf

Wright, P. K. (2001). *21st century manufacturing*. Prentice Hall

Yoshino, N., & Taghizadeh-Hesary, F. (2016). Major challenges facing small and medium sized enterprises in Asia and solutions for mitigating them. *Working Paper, No: 564*, 4-11.

Australian Bureau of Statistics. (2001). Small business in Australian. http://www.abs.gov.au/ausstats/abs@.nsf/mf/1321.0

SA Government Paper No. 102. (1996). The National Small Enterprise Act. http://www.thedti.gov.za/business_regulation/acts/small_business_amendment_act.pdf

APPENDICES

Appendix A: Interview Schedule on Lean

INTERVIEW SCHEDULE FOR UNDERSTANDING IMPACT OF LEAN MANUFACTURING IMPLEMENTATION IN MANUFACTURING BASED SMMEs

I. Opening

a. **Introduction:** My name is Robin Mabunda. I was advised that you are the best person to engage regarding your company's experience with implementing lean manufacturing.

b. **Purpose:** I'm currently undergoing a research study towards an attainment of a masters of technology qualification in Industrial Engineering at the University of Johannesburg. The primary objective of this study is to determine the impact of Lean amongst manufacturing SMMEs based in Gauteng, with an intention of using the findings to help similar companies contemplating an implementation or about to implement a similar concept to understand factors that lead to a successful implementation.

c. **Time Line:** The interview should take about 20 minutes.

d. **Company background:** Can you kindly confirm your role in this organization, period you've worked here and lastly, your previous experience with Lean prior this organization?

Transition: I would like to confirm that the information provided by you in this study will be used for research purposes only. All personal information (if provided) including company name will be kept confidential and will not be disclosed to anyone else or used for other purposes. Your participation in this interview is voluntary and you are free to withdraw from this interview at any time you wish so.

II. Interview Questions

a. Organizational Profile

i. What products does your organization produce?

ii. When did you start with the lean programme?

iii. How many employees did you employ at the start of the lean implementation?

iv. How many employees do you currently employ?

v. What was the name of your lean initiate/programme?

vi. How long was the implementation phase of lean in your organization?

b. Aim(s)

i. What was your organization's reason for implementing Lean?

ii. Was there a formal business case that was developed?

c. Preparation Phase

i. Did you apply change management principles prior implementation?

ii. Did you have a change management plan?

iii. Do you still have a copy of the plan that you can share with me?

iv. Did you procure the services of external resources/consultants for change management or was it all internal work?

v. Did you identify a lean champion prior implementation?

vi. Did the champion have lean and/or lean implementation experience?

vii. Did you procure the services of external resources/consultants for the lean initiative/programme?

viii. Did you identify other role players for the implementation and what were their role?

ix. Did you budget for the implementation?

x. Who was involved in the budget process?

xi. What guided the budget line items?

xii. Are you able to share a copy of initial lean budget?

xiii. If not, can you please give me an indication of the line items in your budget?

xiv. Did have an implementation plan?

xv. Are you able to share that plan with me?

d. Lean Implementation Phase

i. What was the approach to implementing? Was it train-the-trainer or on the job coaching or other (please elaborate)?

ii. What lean principles & techniques were you (as an organization) trained on?

iii. Which lean principles and techniques did you (as an organization) implement?

e. Lean Impact on Business Results

i. How did you measure the impact of each lean technique as you implemented?

ii. Are you able to share those results with me?

iii. How did the impact of each technique impact your business results?

iv. How sustainable were those results?

v. Would you say the lean implementation was a success or failure?

f. Sustaining Mechanisms

i. Did you have governance structures to support the initiative?

ii. Did you pay employees to participate in the initiative?

iii. Did you have a reward or recognition system to support the initiative?

iv. What was the role of the external resources/consultants after initial implementation?

g. Learning

i. Would you say the aim(s) of implementing lean were realized?

ii. What factors would you say contributed to the lean outcome that you had?

iii. In hindsight, how would you have approached the implementation knowing what you know now?

iv. How were change management issues addressed?

v. What would be your advice for any company embarking on this journey?

Transition: Well, it has been a pleasure learning about your lean journey. Let me briefly summarize the information that I have recorded during our interview.

III. Closing

a. **Summarize:** Your company implemented lean using _____

_____ programme. Your approach was_____

_____ and the impact has been_____

.

b. **Maintain Rapport:** I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know so that I can include in my conclusion?

Appendix B: Survey Questionnaire

Dear Respondent

SURVEY QUESTIONNAIRE ON SUCCESS OF LEAN MANUFACTURING IMPLEMENTATION AT SMMEs

Please find enclosed a survey questionnaire form designed to gather information on how your organization's lean manufacturing process was implemented. The primary objective of this study, conducted under the auspices of the Faculty of Engineering and Built Environment at the University of Johannesburg, is to determine the success rate of lean manufacturing implementations amongst manufacturing based SMMEs, identify the factors or drivers that influence and eventually determine the successful implementation of lean manufacturing.

The definition of lean manufacturing (lean) used in this survey is, "*a deliberately way of thinking about "customer value" and how we can deliver this value in the most efficient way"*. Typical lean approaches that are found in South Africa are: Mission Directed Work Teams (MDW), 20 Keys, TRACC, Toyota Production System (TPS), Total Quality Management (TQM) and Lean.

A brief background about me:

My name is Robin Mabunda, a Master of Technology (M-Tech) Industrial Engineering student at the University of Johannesburg, currently undergoing a research study towards an attainment of the above-mentioned M-Tech qualification.

Please take a few moments to complete the attached questionnaire, which should not take longer than 10 minutes of your valuable time. Please e-mail your responses directly to my e-mail address: robin@cdi.biz, or fax to: 086 6190294 by not later than 16 May 2018.

The information provided by you in this questionnaire will be used for research purposes only. All personal information (if provided) will be kept confidential and will not be disclosed to anyone else or used for other purposes.

Thank you in advance for your time and willingness to participate. The results of this survey will be available at the end of August 2018 and I will gladly share them with you if you supply your e-mail address.

Yours Sincerely,

Robin Mabunda: Master of Technology Student, University of Johannesburg

Lean Manufacturing Implementation Success in Small-Medium-and-Micro Manufacturing Enterprises

QUESTIONNAIRE FOR SURVEY

Instructions for completion:

1. Complete all the sections and questions.
2. Please tick the box next to your choice or fill in your answer in the blank field
3. Forward the questionnaire to as many as possible of your colleagues/associates for completion and forwarding to the researcher.
4. Forward completed questionnaire by no later than 16 May 2018 by means of e-mail to robin@cdi.biz or fax to: 086 6190294

SECTION A: Organization Profile

A.1. Name of respondent (Optional)? Click here to enter text.

A.2. Name of organization (Optional)? Click here to enter text.

A.3. Period/how long the organization's been in existence? Click here to enter text.

A.4. Your designation at the organization? Click here to enter text.

A.5. Your role in the lean implementation process? Click here to enter text.

A.6. Period/how long you've been employed by the organization? Click here to enter text.

A.7. Geographical location of your organization (Province & Town)? Click here to enter text.

A.8. Organization main products? Click here to enter text.

A.9. Number of employees? ☐ 1-10 ☐ 10-50 ☐ 50-250 ☐ >250

A.10. Name Lean Manufacturing approach used by your company? Click here to enter text.

A.11. How long was the implementation phase of lean in your organization? Click here to enter text.

SECTION B: Planning and Change Management Phase

B.1. What were the aim(s) of the lean implementation?

Aim	**Instruction** - Please indicate to what extent you agree with the following statements by clicking box on column of your choice				
	Strongly Disagree (1)	**Somewhat Disagree (2)**	**Neutral (3)**	**Somewhat Agree (4)**	**Strongly Agree (5)**
Improve employee engagement	☐	☐	☐	☐	☐
Achieve agile manufacturing	☐	☐	☐	☐	☐
To drive customer focus/centricity	☐	☐	☐	☐	☐
Cost Reduction	☐	☐	☐	☐	☐
Improve quality	☐	☐	☐	☐	☐
Improve productivity	☐	☐	☐	☐	☐
A stepping stone towards ISO quality certification	☐	☐	☐	☐	☐
Other (Please specify) Click here to enter text.	☐	☐	☐	☐	☐
Other (Please specify) Click here to enter text.	☐	☐	☐	☐	☐

B.2. The organization's understanding and adoption of change management process prior implementation?

Change Management	**Instruction** - Please indicate to what extent you agree with the following statements by clicking box on column of your choice

	Strongly Disagree (1)	Somewhat Disagree (2)	Neutral (3)	Somewhat Agree (4)	Strongly Agree (5)
Your organization has a fair understanding of change management approaches (in general)	☐	☐	☐	☐	☐
A change management plan was drafted before commencement of lean implementation	☐	☐	☐	☐	☐
There was a lean steering committee formed to drive lean implementation	☐	☐	☐	☐	☐
There was adequate time planned for all employees to be trained, coached and supported in the implementation	☐	☐	☐	☐	☐
An all-inclusive lean project plan was developed with metrics for success clearly outlined	☐	☐	☐	☐	☐
There was executive or senior management team commitment towards lean implementation	☐	☐	☐	☐	☐
There was executive or senior management sponsorship and visibility in the planning phase	☐	☐	☐	☐	☐

B.3. Budget and Skills Availability within the Organization?

Budget & Skills	**Instruction** - Please indicate to what extent you agree with the following statements by clicking box on column of your choice				
	Strongly Disagree (1)	**Somewhat Disagree (2)**	**Neutral (3)**	**Somewhat Agree (4)**	**Strongly Agree (5)**
The organization had/has an internal resource who was/is afforded adequate time to guide with the change management process	☐	☐	☐	☐	☐

The organization had/has an internal resource who was/is afforded adequate time to guide with lean implementation (from training to execution)	☐	☐	☐	☐	☐
There was/were external resource(s)/consultant(s) that were hired to help guide, coach and implement lean in the organization	☐	☐	☐	☐	☐
The implementations team/leader had implemented the approach at least once at another organization prior your organization implementation	☐	☐	☐	☐	☐
There was a budget determined purely for lean prior implementation and it adequately catered for all planned activities	☐	☐	☐	☐	☐
Funds were/are always made available everytime a justified request was/is made to implement something that would realize an improvement	☐	☐	☐	☐	☐

SECTION C: Lean Manufacturing Implementation Phase

C.1. Which of the following lean tools and techniques was your organization trained on?

Tools/Techniques	**TRAINED?** Indicate Yes or No	
	YES	**NO**
Value Stream Mapping	☐	☐
Visual Management (of Safety, Quality, Delivery/Speed, Cost, & Morale/People)	☐	☐
A3 Thinking	☐	☐
Work Standardization	☐	☐
7 QC Tools	☐	☐

5S (Workplace Orderliness)	☐	☐
Autonomous Maintenance	☐	☐
Overall Equipment Effectiveness	☐	☐
SMED	☐	☐
Total Productive Maintenance	☐	☐
Kanban or JIT	☐	☐
8 Wastes	☐	☐
Hoshin Kanri	☐	☐
Poka Yoke	☐	☐
Other (Please Specify) Click here to enter text.	☐	☐
Other (Please Specify) Click here to enter text.	☐	☐

C.2. Which of the following tools and techniques were used during the lean implementation phase?

Tools/Techniques	**WAS TECHNIQUE USED?** Indicate Yes or No	
	YES	**NO**
Value Stream Mapping	☐	☐
Visual Management (of Safety, Quality, Delivery/Speed, Cost, & Morale/People)	☐	☐
A3 Thinking	☐	☐
Work Standardization	☐	☐

7 QC Tools	☐	☐
5S (Workplace Orderliness)	☐	☐
Autonomous Maintenance	☐	☐
Overall Equipment Effectiveness	☐	☐
SMED	☐	☐
Total Productive Maintenance	☐	☐
Kanban or JIT	☐	☐
8 Wastes	☐	☐
Hoshin Kanri	☐	☐
Poka Yoke	☐	☐
Other (Please Specify) Click here to enter text.	☐	☐
Other (Please Specify) Click here to enter text.	☐	☐

C.3. Which of the following tools and techniques were found to be the most consistently used and considered appropriate for your organization?

Tools/Techniques	**Was Technique Appropriate?** Indicate Yes or No	
	YES	**NO**
Value Stream Mapping	☐	☐
Visual Management (of Safety, Quality, Delivery/Speed, Cost, & Morale/People)	☐	☐

A3 Thinking	☐	☐
Work Standardization	☐	☐
7 QC Tools	☐	☐
5S (Workplace Orderliness)	☐	☐
Autonomous Maintenance	☐	☐
Overall Equipment Effectiveness	☐	☐
SMED	☐	☐
Total Productive Maintenance	☐	☐
Kanban or JIT	☐	☐
8 Wastes	☐	☐
Hoshin Kanri	☐	☐
Poka Yoke	☐	☐
Other (Please Specify) Click here to enter text.	☐	☐
Other (Please Specify) Click here to enter text.	☐	☐

C.4. Implementation approach of lean in your Organization?

Implementation approach	**Instruction** - Please indicate to what extent you agree with the following statements by clicking box on column of your choice				
	Strongly Disagree (1)	**Somewhat Disagree (2)**	**Neutral (3)**	**Somewhat Agree (4)**	**Strongly Agree (5)**

The implementation approach started with a pilot area before rolling out to other parts of the organization	☐	☐	☐	☐	☐
The implementation was planned and executed on a big bang approach (i.e. to cover the entire organization from the onset at one go)	☐	☐	☐	☐	☐
The entire organization ultimately implemented lean albeit big bang or progressively through pilots	☐	☐	☐	☐	☐
The lean approach was an off the shelf package that was not customized to organizational pre-disposition (i.e. terminology, examples etc.)	☐	☐	☐	☐	☐
There was an emphasis in creating employee ownership when implementing actual lean concepts at different areas and levels or the organization	☐	☐	☐	☐	☐
There was a recognition system that was set-up and rolled-out during lean implementation	☐	☐	☐	☐	☐
Other (Please specify) Click here to enter text.	☐	☐	☐	☐	☐
Other (Please specify) Click here to enter text.	☐	☐	☐	☐	☐

SECTION D: Lean Manufacturing Assessment

D.1. How well did your organization follow the implementation approach and plan?

Review & Governance Structures	**Instruction** - Please indicate to what extent you agree with the following statements by clicking box on column of your choice				
	Strongly Disagree (1)	**Somewhat Disagree (2)**	**Neutral (3)**	**Somewhat Agree (4)**	**Strongly Agree (5)**

A Steering committee governance structure existed to review implementation progress against plan and agree on actions to address deviations	☐	☐	☐	☐	☐
Change management issues formed part of the steering committee governance structure	☐	☐	☐	☐	☐
A method for reviewing implementation progress existed and was reviewed at least monthly	☐	☐	☐	☐	☐
There was a structured review mechanism with external people at specified intervals that occurred in your organization	☐	☐	☐	☐	☐
There was adherence to all steering committee meetings and actions to be done	☐	☐	☐	☐	☐
Implementation status formed part of senior management or executive monthly meeting	☐	☐	☐	☐	☐
Periodic recognition sessions were held with teams that had achieved substantial improvements & progress	☐	☐	☐	☐	☐
There was management involvement in coaching teams towards understanding of lean tools and techniques	☐	☐	☐	☐	☐
Periodic progress reports were distributed and discussed with all key stakeholder as per steering committee standard	☐	☐	☐	☐	☐

D.2. What did your organization achieve using the lean approach?

Lean Successes	**Instruction** - Please indicate to what extent you agree with the following statements by clicking box on column of your choice				
	Strongly Disagree (1)	**Somewhat Disagree (2)**	**Neutral (3)**	**Somewhat Agree (4)**	**Strongly Agree (5)**
Are the focus areas of Safety, Quality, Delivery/ Speed, Cost & Morale/People adequate to measure productivity improvement in your organization	☐	☐	☐	☐	☐

Were there actual improvement of Safety, Quality, Delivery/Speed, Cost & Morale/People after lean implementation as compared to before lean	☐	☐	☐	☐	☐
Was your organization able to directly link some or most of the productivity improvements achieved with lean tools & techniques	☐	☐	☐	☐	☐
Did the change management process make any difference to the lean implementation outcome	☐	☐	☐	☐	☐
Was your organization's lean aim realized	☐	☐	☐	☐	☐
Lean implementation has been a success in your organization	☐	☐	☐	☐	☐
Lean tools & techniques have been sustainable	☐	☐	☐	☐	☐

SECTION E: Lean Manufacturing Learnings

E.1. What factors (if any) contributed to the success of lean in your organization?

Click here to enter text.

E.2. What were the barriers (if any) to implementing lean and/or realizing success?

Click here to enter text.

E.3. How were change management issues addressed?

Click here to enter text.

E.4. Over what period has the success been measured?

Click here to enter text.

E.5. List the changes and the level of sustainability of the success seen?

Change	Success was sustained	Tended to fail
Click here to enter text.	☐	☐
Click here to enter text.	☐	☐
Click here to enter text.	☐	☐
Click here to enter text.	☐	☐

E.6. Is there anything else that has not been covered above that you wish to say about your organization's Lean implementation?

Click here to enter text.

E.7. Would you like a copy of the findings? ☐Yes ☐No

If so, please supply your e-mail address. Click here to enter text.

THANK YOU FOR TAKING THE TIME TO COMPLETE THIS QUESTIONNAIRE

YOUR VIEWS ARE IMPORTANT AND WILL REMAIN CONFIDENTIAL.